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WORKING MATERIALS

DAIRY RESEARCH AND MARKETING ADVISORY COMMITTEE

Meeting, February 18-21, 1963 - Ames, Iowa

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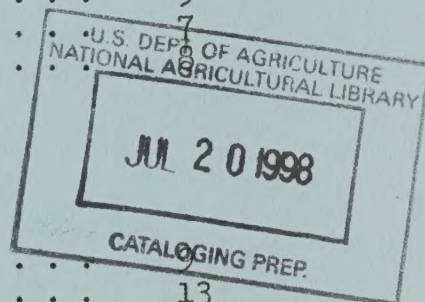
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United States  
Department of  
Agriculture



**National Agricultural Library**

AGENDA  
for the  
DAIRY RESEARCH AND MARKETING ADVISORY COMMITTEE  
February 18-21, 1963

Monday, February 18, 1963

- 8:00 A.M. Assemble in Auditorium - National Animal Disease Laboratory
- Introductions and announcements
  - Tour of Laboratory
  - Administrative and budgetary developments
- 12:45 P.M. Lunch - National Animal Disease Laboratory Cafeteria
- 2:00 P.M. Meet with subject matter groups in rooms to be announced
- 5:00 P.M. Adjourn for the day

Tuesday, February 19, 1963

- 8:00 A.M. Meet in room to be announced to begin review of Farm Research programs
- Animal Husbandry
  - Animal Disease and Parasite
- Noon Lunch. Time to be announced to avoid overcrowding of cafeteria.
- Agricultural Engineering
  - Entomology
  - Soil and Water Conservation
  - Human Nutrition and Consumer-use
- 6:30 P.M. Dinner and Program. Memorial Union, Iowa State University

Wednesday, February 20, 1963

- 8:00 A.M. Meet in same room as previous day. Utilization Research.
- Marketing Research
  - Economic and Statistical Analysis
  - Farmer Cooperative Service
  - Marketing Economics
  - Market Quality
  - Statistical Reporting Service
  - Transportation and Facilities
- Noon Lunch
- Complete Marketing Research
- 3:30 P.M. Board buses for tour of Iowa State University

Thursday, February 21, 1963

- 8:00 A.M. - Review Service and Educational Programs
- Complete any unfinished review
  - Develop Report and Recommendations
- Noon Lunch
- Finish Recommendations and any other business
- 2:30 Adjourn Meeting



UNITED STATES DEPARTMENT OF AGRICULTURE  
 Agricultural Research Service  
 Office of Administrator  
 Washington 25, D. C.

MEMBERS OF THE DAIRY  
 RESEARCH AND MARKETING ADVISORY COMMITTEE

W. H. Austin, Lake Cormorant, Mississippi, who represents southern milk producers, operates a 1,400-acre farm with his son and maintains a 700-cow dairy herd. He is a graduate of the University of Mississippi. He is active in the National Milk Producers Federation as a director and member of the Executive Committee and was recently named first vice-president after having been assistant treasurer. He helped organize the Mid-South Milk Producers Association of Memphis, Tennessee; served continuously on its Board of Directors and is now president. His experiences include president of the State Association of County Supervisors, director of local R.E.A. and P.C.A. and has been active in church work. He was appointed in 1960.

Glenn H. Beck, Manhattan, Kansas, who represents State agencies concerned with research programs, is Dean of Agriculture at Kansas State University. He is a native of Utah and did his undergraduate work at Idaho, received his MS from Kansas State and his Ph. D. from Cornell University. Most of his professional career has been at Kansas except for military service and three years as Head of the University of Maryland Department of Dairy Husbandry. He is a well known judge of dairy cattle and has judged at the American Royal. He has been serving as chairman of the research committee of Great Plains Agricultural Council. He was appointed in 1958.

Alfred W. Brown, New Orleans, Louisiana, who represents distributors of milk and dairy products, is secretary-treasurer and general manager of both Brown's Velvet Dairy Products, Inc. and Brown's Velvet Ice Cream, Inc., the largest milk and ice cream firm in New Orleans. He is an active member of the International Association of Ice Cream Manufacturers and of the Milk Industry Foundation and a director of the Louisiana Dairy Products Association. He graduated from Tulane University. He was appointed in 1956.

Edward B. Evans, Prairie View, Texas, who represents professional service interests concerned with animal health, is President of Prairie View, Agricultural and Mechanical College of Texas. He established the Department of Veterinary Science at the above college in 1918 and the Veterinary Hospital Clinic in 1924. He received his DVM at Iowa State University. He served in World War I. In 1953 he received the Southside Award for Man-of-the-Year in service to agriculture and the Hoblitzelle Achievement Award. He has been recognized for more than 25 years of continuous service to the Texas A&M College system. In addition, he is active in a number of local, State and national organizations. He was appointed in 1962.

Gerald C. North, El Paso, Illinois, who represents research in dairy technology and processing supported with private funds, has been director of New Products for the Beatrice Foods Company since 1956. In this capacity he is responsible for recommending projects for research and development. Beatrice Foods processes a number of dairy and related food products in plants from New York to Honolulu. His undergraduate work was taken at Illinois and graduate work for both MS and Ph. D. degrees at Wisconsin. He developed several specialized dairy products, some of which have been patented by him,



and designed much of the pilot plant equipment used in the research of the company. He owns and leases two farms in Illinois and is active in a number of organizations including Dairy Science, Institute of Food Technologists, Food and Container Institute of Q. M. Refrigeration Research Foundation, and the International Association of Ice Cream Manufacturers. He was appointed to the committee in 1962.

Frank L. Pellissier, Pico Rivera, California, who represents producer-distributors, was reared on a dairy farm and graduated from the University of California. He is secretary and general manager of Pellissier Dairy Farms comprising a herd of about 550 Holstein cows and a distributing service. He is a member of the Dairy Institute of California, a director of the California Dairy Council, vice-president of the American Dairy Association of California, director of the Producers Livestock Marketing Association (Salt Lake), and a member of the California Livestock Sanitary Committee. He was appointed in 1958.

Thomas L. Reeves, Lemon Springs, North Carolina, who represents southern milk producers, operates a 320-acre farm with a dairy enterprise of 80-100 milk cows. He graduated from North Carolina State College, served as Assistant Agricultural Agent in Guilford County prior to military service in World War II. He developed his herd from a small beginning and his operation has been observed by several classes each year from the State College. He was the subject of an article in "Farm Journal" in August 1958. He is active in several local and State organizations. He was appointed in 1962.

Shelby A. Robert, Jr., Biglerville, Pennsylvania, who represents marketing research supported by private funds, assumed new duties with the Musselman Division of the Pet Milk Company early in 1963. Prior to that he was director of marketing research for the Pet Milk Company. He received his B.A. degree at Mississippi State University, M.A. at Louisiana State University, and did additional graduate work at the University of Wisconsin. He served on the staff of USDA for 19 years with responsibility for supervising research on merchandising and product testing including fluid milk and processed dairy products. He was director of marketing research for the American Dairy Association 4 years and in 1959 joined Pet Milk Company. He was appointed in 1960.

Truman Torgerson, Manitowoc, Wisconsin, who represents marketing interests of dairy producers, is general manager of Lake-to-Lake Cooperative. It has plants at Sheboygan, Kiel, Denmark, Green Bay, and Sturgeon Bay, all in Wisconsin. In 1962 it handled 475,000,000 lbs. of milk and is the largest producer of Cheddar cheese in the State. Also, it was the first plant in the Nation to market U.S. AA Grade cheese. Mr. Torgerson is a native of Wisconsin and a graduate of the University of Wisconsin, served as national director of vocational agriculture for 3 years, then as county agricultural agent for 3 years. He helped organize the Lake-to-Lake Dairy Cooperative in 1947 and served as its first and only manager. He is president of the Wisconsin Council of Agriculture Cooperatives and is currently a director of the National Milk Producers Federation. He is active in church and other local organizations. He was appointed to the committee in 1956.



Ruel E. Ward, West Springfield, Massachusetts, who represents food processors and distributors, is in charge of feed research for the Western States Farmer's Exchange. One of his special interests has been the animal nutrition of dairy cattle. He is a native of Minnesota and went to Washington State University for his BS degree and Pennsylvania for his MS and Ph. D. degrees. His experience includes herdsman, milk tester, graduate assistant and research aid. He has been in his present employment for about 20 years which includes translating the results of research into practical farm use throughout the Northeastern States. He was appointed in 1960.

Merrill N. Warnick, Pleasant Grove, Utah, who represents milk producers in the western states, has been a progressive dairy farmer and Holstein breeder for many years. He graduated from Utah State College and has been active in local breed and agricultural associations and affairs. He is a member of the local cooperative milk producers association, a member of the American Farm Bureau Federation, a director on the Board of Holstein Friesian Association of America, and the past president of the American Dairy Association. He was appointed in 1958.

T. Kline Hamilton, Columbus, Ohio, who represents fluid milk processors, is president of Diamond Milk Products, Inc. He was born on a dairy farm, rode his first milk route at age 6, and has been in the dairy business ever since. He spent a year at Ohio State University before going into business. His company has grown from a small beginning and he now has additional business interests. A few of his many activities and accomplishments include organizations of milk distributors; dairy products association; organizer and first president of the Columbus Milk Council; co-organizer of Ohio Dairy Products Research Foundation; director, International Association of Milk Dealers; past president of Milk Industry Foundation; served on a number of State and National industry groups. In 1952 he received the "Award of Merit" from the Department of Dairy Technology, Ohio State University, and was a delegate from the United States to the International Dairy Congress in 1953, 1956, and 1959. He was appointed to the committee in 1963.



UNITED STATES DEPARTMENT OF AGRICULTURE  
AGRICULTURAL RESEARCH SERVICE  
OFFICE OF THE ADMINISTRATOR  
Washington 25, D. C.

DAIRY DEPARTMENTAL WORKING GROUP

Chairman: Max Hinds  
Room 3130-S Ext. 3143

Vice Chairman: J. Sykes  
Room 102 DA-C Ext. 82-406

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EU	B. H. Webb	1644-S	2364	G. C. Nutting W. P. Ratchford	Phila., Pa. " "	
HN	M. Adams	101A NO-C	82-254	C. E. Weir	116A Cn-C	82-338
PR	R. O. White	4133-S	2416	S. C. Billings	4139-S	2416
SWC	L. W. Erdman	126 SS-P	85-638	W. H. Allaway & Nutrition Laboratory Tower Road, Ithaca, N.Y.	U.S. Plant, Soil	

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## FUNCTIONS OF ADVISORY COMMITTEES

The Dairy Committee is one of the twenty-three commodity and functional committees of the U. S. Department of Agriculture established pursuant to Title III of the Research and Marketing Act of 1946. Functions of the members of these committees include:

1. Acquainting themselves with the problems of producers, processors, distributors, and consumers and presenting them for committee consideration.
2. Reviewing the current research and marketing service programs of the Department and recommending adjustments, including terminations, in the current program in order that available funds, personnel and facilities will be used on problems of greatest importance.
3. Recommending new work or expansion of current work and indicating relative priority of such recommendations, when the current program is insufficient to develop solutions for important problems.
4. Developing a better understanding of the nature and value of the agricultural research program, explaining it to interested groups and organizations and encouraging the wider and more rapid application of the findings of research.

The Committees perform an important function in advising with respect to the development of the Department's research and marketing service programs. However, committee members recognize that the development of budgets and the implementation and administration of research and marketing programs are responsibilities of the Department.

Working materials similar to these are prepared for each committee. The areas of the other twenty-two committees are:

Citrus and Subtropical Fruit	Oilseeds and Peanut
Cotton and Cottonseed	Potato
Deciduous Fruit and Tree Nut	Poultry
Economics	Rice
Farm Equipment and Structures	Sheep and Wool
Food and Nutrition	Soil, Water and Fertilizer
Food Distribution	Sugar
Forage, Feed and Seed	Tobacco
Forestry	Transportation and Storage
Grain	Vegetable
Livestock	Home Economics

These working materials were compiled by Max Hinds, Executive Secretary, Dairy Research and Marketing Advisory Committee, Office of Administrator, Agricultural Research Service, U. S. Department of Agriculture, Washington 25, D. C.



## CRITERIA FOR EVALUATION OF RESEARCH NEEDS

In discharging the function of advising the Department on agricultural problems and their relative importance, advisory committees should consider the following criteria in evaluating proposed new or expanded work:

1. Scope or size of problem..... Local, regional, national  
Number of acres, farms, firms, volume  
of product, dollars, etc., involved
2. Character of research..... Basic or applied  
Extent of contribution to present  
program and problems  
Time and manpower required
3. Probable uses or adoption  
of results by..... Producers, consumers, or industries  
Public bodies, research workers
4. Urgency or seriousness..... Health or welfare, economic  
National security
5. Contributory factors..... Cooperation of States and industry  
Availability of special funds,  
facilities, materials, personnel

It is recognized that in the formation of an adequate, dynamic, balanced, and well-coordinated program of research, other factors, in addition to the importance of the problem must be taken into consideration by those responsible for initiation and prosecution of the program. Questions dealing with how, where, by whom, and at what cost the research shall be done are the responsibilities and functions of the scientists and research administrator.

### Cooperation

A large part of the Department's research is cooperative with State Experiment Stations. As most studies have their origin in problems of producers, processors, distributors and consumers, representatives of these groups frequently cooperate in the conduct of the research. The extent of joint planning and cooperation varies with each problem and is done in such a manner as to make full use of the personnel and resources of interested groups with a minimum of duplicative effort.

To show clearly that the committee expects the Department to continue its policy of cooperation in starting new work and expanding current work, the section of the Committee's report entitled "Recommendations for New and Expanded Work" will begin with the following paragraph:

"In recommending new or expanded work on the problems listed in this section, the Committee recognizes that it is not its responsibility to delineate between research to be conducted within the Department and that to be conducted in cooperation with State Agricultural Experiment Stations and other research agencies. The recommendations made by the Committee are in terms of the importance of problems on which research is needed and in which the Department should participate."



## ANIMAL BIOLOGY

## 1. Program Changes in Fiscal Year 1963.

Professional Man-years	: F.Y. 1962	: Changes in	:
	: Base	: F.Y. 1963	:
Program leadership	: .2	: + .1 <u>1/</u>	:
Genetics	: 5.5	: -	:
Physiology	: 0.0	: +8.7 <u>1/</u>	:
Nutrition	: 2.0	: -	:
Rumen function	: 3.5	: -	:
Total	: 11.2	: +8.8	:

1/ Transfer of basic studies on avian anatomy (3.0 PMY) from Area 9 with proportionate share of program leadership (.1 PMY). Also transfer of 2.0 PMY from Area 6 resulting from increased emphasis on basic animal biology studies in dairy physiology. A transfer of 1.0 PMY was made from Area 7 and additional non-recurring support to the amount of 2.7 PMY was obtained for research in radiation biology.

## 2. Plans for Use of Current Resources through Fiscal Year 1964.

The basic nature of the research in avian anatomy indicated the desirability of classifying this activity under animal biology. The Atlas of Avian Hematology was published in 1961 as a USDA Monograph. Nearing completion is the first volume of a series on the organ systems. This volume includes the skin, feathers, and other specialized structures of the body surface. Work is in progress on the other organ systems and these results will be prepared for publication as a series of poultry anatomy atlases.

Another major change in this area has been a reallocation of work from Area 6 relating to physiology of reproduction. Comparative studies on biochemical changes in reproductive tissues and on the defense mechanisms of reproductive organs have been intensified through realignment of work in Area 6 and assignment to Area 1. A portion of similar studies relating to the mammary gland have likewise been reassigned to this area. A laboratory for studies in radiation biology is being established and cooperative studies with Iowa, Utah, Minnesota, and USPHS are underway on counter-measures to radioactive fallout contamination. Nutrition research in this area will be continued at the current level and no major changes in emphasis are projected. Rumen function work will also continue at the present level although somewhat more emphasis is being given to variations in gross rumen metabolism and the relation of these to rate of consumption and utilization of forages.



### 3. Problems Requiring New or Additional Research.

#### Chemistry and Physiology of Hormones.

New work on the chemistry and physiology of hormones is required in order to improve lactational and reproductive performance of farm animals. Studies on the relation of secretion of hormones to persistency of lactation and reproductive performance are urgently needed. Improved methodology for adequately conducting such studies is urgently required. The first studies of this research should (1) ascertain the levels of secretion of hormones and characterize their subsequent metabolism; determine pathways of excretion, localization of hormones or metabolites in the tissues and the enzyme systems responsible for hormone metabolism; (2) study the mechanisms whereby hormones control the metabolic activity of tissues, mammary gland and reproductive tissues particularly, and the alterations during sterility, fertility, pregnancy and lactation; (3) determine the physiological mechanisms involved in uterine function and embryonic mortality; study the interrelationship of the ovarian hormones (estrogen and progesterone), uterine physiology and early embryonic mortality.

#### Protein Synthesis and Energy Metabolism by Ruminal Bacteria.

Much more basic information is needed on mechanisms of bacterial protein synthesis and mechanisms of energy production and utilization by rumen bacteria in order to better understand these very important processes in ruminants. Studies should be initiated on the mechanisms of carbohydrate dissimilation and methane production and the types of energy yielding reactions, e.g., substrate-linked and/or oxidative phosphorylations, and should include work on the amount of cell substance produced per amount of energy source catabolized, electron transport, respiratory pigments, and phosphate uptake, in whole cells and cellular fractions of pure cultures and/or the mixed ruminal flora. Work should be expanded on the mechanisms involved in incorporation of N, C, and S compounds into rumen bacterial protoplasm. Studies should be initiated on the relative efficiency and amount of rumen microbial growth (protein synthesis) in cattle on various dietary regimes. The relation of rumen volume, rate of passage of materials and production of volatile fatty acids,  $\text{CO}_2$ ,  $\text{CH}_4$ , and methane to this process and its effect on digestibility and nitrogen balance should be determined.

#### Chemicals in Livestock Production.

Chemicals in the form of pesticides, herbicides, nematocides, and feed additives have found an essential place in modern crop and livestock production but the metabolism of their residues, their role in metabolic processes, and their ultimate fate in the animal body is not well understood. Expanded research is needed in order to clarify these questions of metabolism and thereby insure optimum benefits to livestock production that are consistent with safe usage. Congress has provided facilities for a Metabolism and Radiation Research Laboratory at Fargo, North Dakota. Additional appropriations are needed to staff this laboratory.



### Countermeasures Against Contamination of Animal Products by Radioactive Fallout.

Radioactive fallout products, Strontium 90, Cesium 137, and Iodine 131, produced during testing and/or use of atomic weapons present an important contamination to man. These materials enter the atmosphere and are incorporated in plant and animal life and are then ingested by man in all of his food products (meat, milk, vegetables, fruits, and grains). Provision should be made to continue research to establish methods and techniques to control and/or modify the physiological processes whereby these fallout radioisotopes are taken into the animal body and deposited in animal products. The use of additives or supplements incorporated into the diet of dairy cattle which would affect absorption and net retention, discrimination by the digestive tract and mammary gland, turnover of the materials and the interrelationship of these biological processes and nutritive factors would be studied.

### Immunogenetics of Sperm and Ova.

Detailed studies of semen antigens may provide information of critical importance in regard to fertility, semen processing, sex control, selection traits, etc. Recent work indicates that genetically controlled antigenic variation occurs in many kinds of tissue cells as well as in red blood cells. These same kind of differences may exist in sperm and ova. Previous investigations show as many as six different antigenic components present in bovine seminal plasma and that these antigens can also be found on the sperm cells. Studies have not progressed enough to determine if sperm have antigens which are not found in seminal plasma.

Detailed studies of sperm and seminal plasma from many different bulls should be made to determine if, as with the case of red blood cells, there is genetically controlled variability between individuals. Similar studies on ova would also be of interest.

### Sperm Separation in Semen Samples.

Man has long dreamed of being able to separate sperm into groups based on gene or chromosome content. Sex control has been the principal aim of previous unsuccessful studies. Availability of new techniques make it desirable to initiate new studies on this problem. Probability of success is low but if evidence of gametic differences due to gene or chromosome content were found it would have tremendous possibilities including sex control and direct selection for other traits.

### National Animal Germ Plasm Laboratory.

Long time storage of cattle semen is a reality and has a potential of extreme usefulness in both breeding research and commercial practice. On the other hand the storage of ram and swine semen for more than a few hours without reduction in fertility is not now possible. Consequently, the use of artificial insemination in these species is limited and other applications of long time semen storage in breeding research and commercial



practices are prevented. Furthermore, the preservation or growing of sperm producing tissue, ova, and ovarian tissue in all species is an unexplored field of research with great potential value. Research on an adequate scale should be initiated on methods of preserving farm animal germ plasm for long periods of time and on ways of using the methods developed to permit further progress and evaluation of the progress in the application of new breeding techniques.

#### Effect on Feed Efficiency of the Rumen Function.

Improvements in feed efficiency by ruminants depend to a large extent on increased knowledge of the rumen, its function and the enzymatic conversion which take place in it. The identification into nutritive requirements of important microorganisms of the rumen, relation of feed additives and the physical form of feed to the function of the rumen and its microorganisms should provide information for formulating feed mixtures and feeding methods capable of promoting more efficient use of forage and other feeds in ruminant production. Basic and applied research should be expanded on these complex problems to bring about improved estimates of the feeding value of forages as well as other feedstuffs. Investigations should include the effects of various feeds and systems of feeding on the quality of products produced and the contribution of ruminal microorganisms to nitrogen metabolism.

#### Blood Typing Research.

The extensive and productive research on cattle and poultry blood typing has been carried out only to a limited degree with other types of livestock. Furthermore, the preliminary studies on the relation of cattle blood types to economic traits, such as milk production and growth, have been inconclusive and even conflicting. Research is needed to provide additional, basic knowledge of the antigenic factors, particularly in swine and sheep. Equally important is the development of additional laboratories which have the capability of handling large numbers of samples and which are associated with computing facilities for the purpose of assaying the relationship of blood antigens to economic traits, not only in terms of individual factors but also in regard to differences in complete blood types. The work should also have sufficient scope to include the interrelationship of blood antigens and other polymorphisms such as  $\beta$  globulins,  $\beta$  casein,  $\alpha$  casein, and hemoglobin. The detailed understanding of the inheritance of these specific physiological characteristics, when combined with quantitative approaches commonly used for economic traits, may well lead to a breakthrough in the fundamental knowledge and control of inheritance in our livestock.



## DAIRY CATTLE-BREEDING

## 1. Program Changes in Fiscal Year 1963:

Professional Man-years	F.Y. 1962 Base	Changes in F.Y. 1963
Program leadership	1.2	
Genetics and interrelations of performance traits	7.2	-1.2 $\frac{1}{2}$
Performance testing	2.3	+1.0 $\frac{2}{2}$
Selections and systems of breeding	11.0	
Total	21.7	-0.2

1/ Work on body conformation and internal organs discontinued except for summation and publication of data.

2/ Additional man for expanded research.

## 2. Plans for Use of Current Resources through Fiscal Year 1964

Data collection on the genetics and interrelationships of body measurements and measurement of internal organs from post-mortem studies and their relationship to milk production have been terminated and final analysis of the data is in progress. Funds freed by this termination have been divided between management investigations in "Dairy Cattle - Nutrition and Management" and physiology studies in "Dairy Cattle - Physiology". Support amounting to 2.3 professional man-years will be shifted in 1946 from "Production Influences on Animal Products" to permit expansion of effort on the National cooperative sire evaluation program. Exploratory investigations of the possible genetic influence upon milk flavor variation between individual animals will be initiated. This work will be cooperative with the Eastern Utilization Research and Development Division. Limited investigations will be started on the genetic and environmental influences affecting milking rate of individual animals and the concurrent development of accurate and practical means of measurement. Plans are being developed at Wisconsin to initiate research on the expression of milk and meat-producing traits of Holstein cattle maintained under different nutritonal and management regimes. This work will replace the inbreeding studies which are nearing completion. Studies on the genetics and interrelation of economic traits and the longtime basic studies on selection and systems of breeding will be continued at the present level.

## 3. Problems Requiring New or Additional Research

Improved Sire Evaluation

The National Dairy Herd Improvement and Sire Proving Program is effective in maintaining and improving the efficiency of the Nation's dairy herd and in helping farmers adjust to changes in demand and prices for dairy products. It provides records by which a dairyman can eliminate low producing cattle and carry out more efficient feeding and management. It provides an objective basis for identifying cows and sires of superior genetic merit and in this respect is of particular importance to the artificial insemination programs of the Nation.



Needs in this work are (a) increased frequency of sire-evaluation summaries and (b) investigations of problems affecting the accuracy of sire evaluation. The industry as well as the Dairy Research and Marketing Advisory Committee has consistently urged that sire evaluations be made at more frequent intervals. The rapidly increasing volume of data has prohibited this in this past.. A number of research problems relevant to sire evaluation justify this study. For example: (1) inter-stud comparison of artificial insemination sires - the relative magnitudes of differences between studs and differences between sires within studs with respect to contemporary comparison sire ratings; (2) extending records terminated by culling - appropriateness of extension factors derived from completed lactations for partial records of cows culled on production; (3) techniques for increasing the reliability of single herd sire evaluations.

#### Heritability of Surface Evaporation

Laboratory experiments have shown that there are large variations among animals in certain physiological characteristics which enable them to adapt to heat stress. Of these mechanisms, the variation in surface and respiratory evaporative losses are of primary importance, although at present the most promising appears to be surface evaporation. The extent to which progress can be made in changing this characteristic has not been determined; therefore, work should be initiated in which the variations of these characteristics will be determined on large numbers of dairy cattle under varying stress conditions. The data will then be subjected to appropriate analysis as a basis of determining the heritability of these traits and developing selection coefficients.

#### Genetic and Environmental Studies on Milking Rate in Dairy Cattle

Studies show a range in rate of milking between individual cows from 2 to 14 minutes. Information is limited, however, as to how effective we might be in selecting for this trait. Practically no evidence exists relating this trait to other desirable traits in dairy cattle. A clear understanding should be developed on relationships between rate of flow, milk production, and udder health. These factors would be extremely valuable in determining the kind of dairy animal that is the most economical producer for the commercial dairyman. Studies should be initiated to gather information on the interaction between various modifications of the milking machine and rate of milk flow, completeness of milking, and udder health of individual cows. These studies would be carried out on animals in the breeding herd and also on identical twins or other closely related animals. Measurements should be taken at frequent intervals throughout the lactation and over different lactation numbers to see how these factors relate to the entire problem.

#### Genetic and Management Relationships of Meat and Milk Production by Dairy Cattle

The United States is second only to the United Kingdom as an importer of meat. These imports increased 25 percent from 1960-61. A much greater meat supply could be produced by U.S. livestock farmers if dairy steers or bulls were allowed to more nearly approach maturity before they are slaughtered than is presently the case. Such a practice could also supplement the income of the dairy farmer. Research needs to be carried out to determine genetic relationships between milk-producing capacity of cows and rate of gain or fattening ability of their offspring. Sire groups from experimental breeding herds should be fed out under standard conditions to determine variations within the breeds for meat production and their relationship to half-sib sisters in milk production. Data gathered should include rate of gain, total gain, degree of finish, economy of gain, and such carcass characteristics as palatability,



flavor, tenderness and dressing percentage. Additional studies should be made on management methods most suitable to producing economical and acceptable carcasses. Various types of rations and management systems should be tried. Bulls should be compared with steers under various environmental conditions. Such studies would serve to point out the economic feasibility of beef from dairy animals.

#### Genetic and Environmental Factors Affecting Milk Flavor and Other Quality Characteristics

Limited work in the area of milk flavors indicates important variation among individual cows in the flavor of fresh milk, stability of stored milk and in manufacturing of dairy products. These variations on a herd basis greatly influence the quality of products prepared from the milk. Very few studies have been done to determine the genetic influences on flavor and little work on management influences. It is important to find out what factors are responsible for these differences in flavor to insure that the increased emphasis on production and economy of production does not decrease the desirability of our product from a flavor standpoint. Milk samples and products from individual cows would be evaluated by laboratory analysis for objective characterization and by a panel of judges for organoleptic evaluation. All possible measurements of the environment should be recorded to learn about the importance of such things as season, age, stage of lactation, gestation, temperature, humidity, feeding and other management procedures in current use. This work will be cooperative with E.U.R.D.

#### Genetic and Phenotypic Relationships among Physiological Traits in Dairy Cattle

Methods of early detection of superior animals is important in improving the merit of the U. S. herd and decreasing the cost of herd replacement. A large amount of work has been done in an attempt to relate gross measurements with growth and production. Some of the work indicates that an investigation of physiological capacities would be a fruitful line of approach. Such things as growth hormone levels, enzyme levels, blood constituents, blood volume, liver and kidney function should be studied at frequent intervals throughout the life of dairy animals. These traits would then be compared with growth and production characteristics. We should also make a detailed histochemical study of developing and mature mammary glands and tissue in an effort to discover characteristics related to differences in production between individuals and genetic groups. This is basic research aimed at looking beyond gross products of inheritance to the physiological pathways between genes and the characters they control.

#### Milk Composition

Much interest has arisen throughout the country and the milk industry concerning testing methods for protein and solids-not-fat and the effects of such things as genetics, feeding, environment, etc., on these constituents. Recent comparative tests indicate that there may be more variation in results between laboratories than was anticipated. Tests must be developed further and standardized before they can be considered adequate for milk payment or studying genetic and environmental influences. The influences of feed and management on protein and other solids-not-fat components also should be investigated.



Still other individual milk components need extensive study. Recent tests show at least four different milk proteins are controlled by genetics. Many other constituents should be investigated. We have the only herd in the world that is currently being tested for blood antigens, d casein, B casein and B lactoglobulin. Attempts should be made to study variation occurring in other important constituents of milk such as amino acids, fatty acids, enzymes, vitamins and minerals. Other studies are needed to investigate genetically controlled polymorphisms such as B globulin and hemoglobin in blood.



## DAIRY CATTLE - PHYSIOLOGY

## 1. Program Changes in Fiscal Year 1963.

Professional Man-years	F.Y. 1962 Base	Changes in F.Y. 1963
Program leadership	.3	
Physiology of reproduction	2.7	+0.2 <u>1/</u>
Physiology of milk secretion	4.0	-2.0 <u>2/</u>
Physiology of growth and development	1.0	
Environmental physiology	.6	+0.9 <u>3/</u>
Total	8.6	-0.9

1/ Through shift of funds from Dairy Cattle - Breeding (Area 5).

2/ Reallocation to Animal Biology - (Area 1).

3/ Resulting from increase of 1 man-year which was obtained through transfer of 0.9 man-years from Dairy Cattle - Breeding (Area 5) and 0.1 professional man-year from Maryland cooperative agreement funds.

## 2. Plans for Use of Current Resources through Fiscal Year 1964

Work on the physiology of reproduction of dairy cattle has been increased through a shift of funds from Area 5. Existing research on physiology of milk secretion has developed into basic biologic studies to such an extent that they are more applicable to animal biology than strictly dairy physiology. Therefore, 2.0 professional man-years have been shifted to Area 1. Work will continue on biochemical changes in the mammary gland, in the blood and rumen in relation to lactation and on the influences of nutrition and hormones on these changes. Studies on biochemical and tissue changes in the mammary gland related to the defense mechanisms of the gland in response to infections and mastitis also will continue. Work on the physiological aspects of dairy cattle adaptability has been increased by 1.0 man-year.

## 3. Problems Requiring New or Additional Research

Physiology and Biochemistry of Mammary Tissue

Development of more efficient mammary gland tissue might be possible if the fundamental processes involved in mammary gland growth were known. Physiological, biochemical and histochemical studies of bovine mammary tissue should be initiated and expanded with particular attention paid to development and changes with age and variation between individuals. The studies should investigate the enzymatic activities of the mammary gland related to the synthesis of milk, the effects of hormones upon the metabolic activity of the tissue, and the metabolism of the hormones by the mammary gland tissue during their action. The study should include suspensory as well as secretory tissues of the udder.

Hormonal and Dietary Control of Fat Metabolism

Basic research should be initiated to determine the hormonal and dietary factors which affect fat metabolism. A sex difference in fat, cholesterol, B-lipoproteins, etc., suggests that hormones may influence fat metabolism and type of fat produced by cattle either directly or possibly through an influence on rumen metabolism which in itself is characterized by the production of



large quantities of fatty acids or their precursors. Ration alterations in some animals at least produce considerable change in the type of fat deposited. Effort should be made to determine whether the characteristics of milk fat can be materially altered by variations in rations or by altering rumen metabolism.

### Heat Stress Physiology

The ability of cattle to adapt to environmental stress has been shown to involve complex physiological changes. Expansion of current research and initiation of new areas of research relating to physiological changes related to heat stress and adaptation are required in order to develop techniques for minimizing the effects of stress and thus improve production efficiency. Preliminary evidence indicates that many internal adjustments occur in response to heat stress. These include changes in blood constituents, rumen fatty acid levels, urinary constituents and hormone secretion. A large amount of detailed work on these metabolic variations and on the factors which control them will be required in order to develop procedures which will enable cattle to adapt more readily to stress and to reduce those processes which are related to lower production.



## DAIRY CATTLE - NUTRITION AND MANAGEMENT

## 1. Program Changes in Fiscal Year 1963

Professional Man-years	F.Y. 1962 Base	Changes in F.Y. 1963
Program leadership	0.9	
Digestion and metabolism	6.0	+1.0 <sup>1/</sup>
Forage evaluation and utilization	11.1	-3.0 <sup>2/</sup>
Nutritional requirements	2.6	+0.5
Calf feeding	3.1	+0.5
Management practices, equipment and facilities	2.7	
Totals	26.4	-1.0

1/ Includes two additional professional man-years shifted from Forage Evaluation and Utilization and 1.0 person shifted from Digestion and Metabolism to Animal Biology (Area 1).

2/ Funds shifted to shore up projects within the area.

## 2. Plans for Use of Current Resources through Fiscal Year 1964

Work on the microbiological aspects of silage fermentation (3.0 PMY) has been discontinued and funds utilized to shore up other aspects of work in this area. Pasture evaluation work at the Western Washington Experiment Station, Puyallup, Washington, has been discontinued and funds shifted to research on silage. Work on vitamin A and magnesium deficiency of calves has been completed and increased emphasis is being given to utilization of forages by growing heifers. Work on the energy requirements of grazing cattle has been terminated for the present and one project on maintenance requirements of mature dry cows has been completed and the funds shifted to other aspects of work. It is projected that work at Willard, North Carolina, and Puyallup, Washington, involving silage preservation and evaluation, pasture and forage utilization and calf-feeding will be terminated as of July 1, 1963, and the funds shifted to support similar work at Beltsville. Also, with the establishment of the Animal Husbandry Radiation Biology Laboratory, one professional man-year was moved into Area 1 in support of this activity. In total, these shifts have resulted in more adequate support being given to digestion and metabolism and energy metabolism work.

Work on environmental factors affecting mastitis and on physical means of fly control is increasing as facilities are becoming available. Comparisons on hand vs. machine milking have been completed. Work is continuing on the evaluation of dairy equipment and dairy farm layouts. Exploratory investigations of the antibodies of milk for young calves are continuing. Studies on antibiotic markers have been completed. (Because of the increased activity in management practices, equipment and facilities, this work is to be set up as a separate area for the next fiscal year.)

## 3. Problems Requiring New or Additional Research

Biochemistry and Physiology of Feed Consumption

More precise knowledge is needed concerning the characteristics of feeds, particularly forages which affect their acceptance by dairy cattle. An inadequate intake of a forage reduces its usefulness as a source of nutrients for



dairy cattle. Differences in acceptability between strains of grasses within a species as well as differences in nature and amount of feed consumption among cattle have been noted.

Research relating to the factors which affect consumption, including feed composition, rumen metabolism, and the relation of these to milk production and milk composition is required to provide a basis for maximum efficient utilization of feeds for dairy cattle.

#### Effect of Physical State of Feeds on their Utilization

Recent observations have shown that the grinding and pelleting of forages under certain conditions improves their consumption and results in greater milk production and rate of growth. There is a real need for fundamental and practical studies to develop an understanding and evaluation of the effects of the physical form of feeds on their utilization and their side effects. In addition to the observations mentioned above, other reports claim that the steam treatment of concentrates under certain specified conditions improves the efficiency of utilization of the energy of the ration. One feed company has now placed a feed concentrate on the market utilizing this possibility. Also, certain side effects occur with pelleted forage such as lowered fat test, defective carotene utilization and parakeratosis.

#### High Concentrate Rations for Dairy Cattle

The ability of dairymen to adapt their practices to changes in the economics of feed supplies is dependent not only on knowledge of maximum and optimum use of forages but also of concentrates. Research is required to determine whether dietary supplements need to be supplied when high proportions of concentrates are fed. The studies also should determine the minimal amount of forage needed by dairy cattle. The need for this work is accentuated by the findings that protection of the milk supply from fallout contamination can be accomplished by greater reliance on concentrates and stored feeds than on pasture feeding or green chop. Also, the increased efficiency in the production of corn and cereal crops is making their nutrients available at less cost than nutrients from forages and is raising fundamental questions concerning dairy cattle nutrition.

#### Influence of Nutritional Management on Adaptability

Recent evidence has shown that productive performance of dairy cattle in stressful environments is affected by the nutritional management to which the cattle are subjected. In particular, the form in which the energy is provided is important to the general tolerance of lactating cows to high temperatures. Expansion of research, which will include the study of high and low fiber rations, high energy rations including various forms of roughage under varying environments is urgently required. The utilization of forage crops as green chop vs. pasturing and comparisons of dry lot feeding with alternative systems as a means of ensuring adequate feed intake under stressful environments should be evaluated. The development of rations and forage utilization systems suitable to a wide variety of environmental conditions would be an important product of this research.

#### Dairy Farmstead Layout and Management

Dairy farmers need information on improved layout, building arrangements, methods and equipment to assist them in reducing excessive man-hour requirements, eliminating drudgery and increasing returns from their operations.



Integrated engineering, economic and husbandry research should be initiated by establishing a farm-size laboratory where alternative situations can be compared with controlled management.

This is a national problem involving all dairymen. Improved facilities, equipment and methods are needed in the production of milk. Present labor requirements amount to about 2-1/4 billion man-hours per year, almost all of which are in and around the buildings. Since World War I production per man hour of work in dairy has increased only about 40 percent as much as in crops. Preliminary research and the accomplishments of progressive farmers have suggested the possibility of greatly reducing the unit dairy labor requirements.

The contemplated research is principally applied in character. Personnel would be assigned from the Animal Husbandry Research Division, the Agricultural Engineering Research Division, and the Farm Economics Division of the Economics Research Service. Systems of milking and handling feed, bedding, manure, milk, and cattle would be compared in relation to equipment and structures required. Basic information would be developed to determine the merits of the various equipment structures and management in terms of labor efficiency, cattle performance, milk quality, equipment and structure performance. Experimental structures and equipment would be considered as expendable. Materials used and erection procedures would be based on temporary use.



# NUTRITION OF ANIMALS AS AFFECTED BY PROPERTIES AND CHARACTERISTICS OF SOILS AND PLANTS

## 1. Program Changes during Fiscal Year 1963

Professional Man-years	F.Y. 1962 Base	Changes in F.Y. 1963
Characterize soil and climatic areas where the nutritional status of animals and man is affected adversely by quality of plants produced	1.8	+1.0
Basic understanding of the synthesis and metabolism of nutritionally important substances in plants and animals	3.4	
Biological assays of plant material grown under different soil, geological and other environmental conditions to nutritional disorders in animals and man	1.8	
Elaboration by plants of vitamins, amino acids, proteins and other organic nutrient compounds required by animals	5.0	
<b>Totals</b>	<b>12.0</b>	<b>+1.0</b>

## 2. Plans for Use of Current Resources through Fiscal Year 1964

Work is being continued on the relationship of soil and plant composition to the incidence of muscular dystrophy in livestock. Especial emphasis is being focused on the selenium content of forages, and its variation in different areas. Research directed toward the development and use of selenium fertilizers is being initiated. Studies of molybdenum toxicity in cattle have been completed and work with laboratory animals to clarify some of the mechanisms involved is underway. Studies of cation-anion imbalance in animal diets are being resumed following a discontinuance due to lack of personnel. During the past year, three of the amino acid specific transfer ribonucleic acids were isolated in pure form and efforts to understand the structure of these compounds and the relationship of structure to their function are being intensified. A number of unusual dipeptides have been isolated from plants and the role of these dipeptides in animal nutrition will be evaluated, with a view toward determining the effect of these dipeptides upon amino acid balance and protein quality in plant products.

Work on the mapping of cobalt and copper deficient areas of New England is complete. Attention is currently directed toward delineation of areas in the Pacific Northwest where forage may be so deficient in copper or cobalt as to bring about nutritional troubles in livestock. These studies will be extended to the northern lake states as soon as possible.



### 3. Problems Requiring New or Additional Research

#### Protein Quality and Amino Acid Balance in Plants

One of the most serious nutritional problems on a world basis is protein malnutrition. In the emerging countries plant products will need to meet most of the human protein requirements, and even in advanced countries efficient production of poultry and hogs is dependent upon amino acid balance in plant products. Most often the sulfur containing amino acids are deficient in plants. Research on this problem should be expanded on a broad basis, ranging from studies of the uptake of sulfur by plants to studies of the synthesis and metabolism of protein in plants and the availability to animals of the different sulfur compounds in the plant.

#### Functions and Interrelationships of Micronutrients in the Soil-plant-Animal Food Chain

Research on the pathways followed by micronutrients from soil to plant to animal should be strengthened. Emphasis needs to be directed to interrelationships between the micronutrients of all stages along this food chain. For example, it is recognized that the zinc requirement of animals is higher on diets high in calcium and phytic acid. There is a need to understand how one micronutrient may affect the uptake of others by plant, and the factors affecting utilization of different forms of micronutrients in animals. The proposed research will require soil scientists, plant physiologists, biochemists and animal nutritionists.

#### Nitrates in Vegetables and Other Food and Feed Crops

The nitrate level required in some plants during the early growth stage is quite high. As the plant approaches maturity these nitrate levels normally drop. A better understanding of the metabolism of nitrates in plants as affected by plant species, soil fertility, weather conditions, and stage of growth is needed in order to insure food and feed supplies without excessive nitrate content.



## INFECTIOUS AND NON-INFECTIOUS DISEASES OF CATTLE

## 1. Program Changes in Fiscal Year 1963

Professional Man-years	F.Y. 1962 Base	Changes in F.Y. 1963
Brucellosis	2.3 <sup>1/</sup>	
Paratuberculosis (Johne's Disease)	4.0	+1.0 <sup>7/</sup>
Vibriosis	5.1 <sup>2/</sup>	
Tuberculosis	4.6 <sup>6/</sup>	-2.0 <sup>8/</sup>
Mucosal-respiratory disease-complex	1.1 <sup>3/</sup>	
Mastitis	6.2 <sup>4/</sup>	
Respiratory disease (Shipping fever)	5.0	
Leptospirosis	4.0	+2.0 <sup>9/</sup>
Infertility	3.0	
Epizootic bovine abortion	3.4 <sup>5/</sup>	
Enteric infections	4.0	
Leukosis	3.0	+3.0 <sup>10/</sup>
Foot rot	3.0	+1.0 <sup>11/</sup>
Keratitis	2.0	
Totals	50.7	+9.0

- 1/ Includes cooperative agreements with Maryland, Minnesota and Wisconsin  
2/ " " " " New York.  
3/ " " " " Colorado, Indiana, and Iowa.  
4/ " " agreement " California.  
5/ " " " " "  
6/ " a contract with Michigan.

- 7/ One biochemist to work on isolation and characterization of specific antigens for diagnosis of paratuberculosis (Johne's disease).  
8/ Two bacteriologists to work on characterization and to classify antigenically related mycobacteria to improve methods for diagnosis of tuberculosis.  
9/ One bacteriologist and one serologist to characterize and classify serotypes of leptospirosis and to improve specificity of diagnostic tests for the disease.  
10/ One biochemist, one pathologist, and one virologist to work on leukosis  
11/ One pathologist for studies on foot rot.

## 2. Plans for Use of Current Resources through Fiscal Year 1964

Particular emphasis will be given to the phases of work as shown for each of the cattle diseases.

Brucellosis studies will be initiated to determine the development of *Brucella abortus* Strain 19 in bulls of different ages - evaluation of methods to differentiate species of the genus *Brucella*. Systematic investigation of the complement-fixation test. Continue the assay of sera which give discrepant results on plate and tube tests by immunoelectrophoresis and other physical and chemical methods. Studies of problem herds in an effort to improve present methods used for the detection of infection. Development of procedures for the production of a good vaccine.



A new phase of the study will be instituted on paratuberculosis to determine if the disease is eventually self-limiting in a herd. Investigation of passive transfer of cattle leukocytes sensitized with Mycobacterium paratuberculosis to laboratory animals in relation to study of tuberculin sensitivity in cattle. Continuation of work on enzyme X-108 and on trypsin and toxicity of the enzymes when mixed with M. paratuberculosis.

A new phase of work on vibriosis to determine duration of vibronic infection in digestive organs of cattle and its effects on the liver and gall bladder in relation to sporadic vibronic abortion. Develop a fluorescent antibody technique for detection of vibriosis.

A new approach to the study of tuberculin and M. tuberculosis to nonspecific reactions and the tuberculin response in infected animals. Investigation on the specificity and sensitivity of the crude and purified fractions of mycobacteria by serological methods and sensitized animals.

Trials to produce clinical cases of mucosal-respiratory disease-complex with agents that have been isolated at NADL. Classification of virus isolates, determine relationships between them to the prototype, C24v, new phase of investigations, study extent to which reinfection may occur in presence of circulating antibody. Characterize viral isolates. Study the role of wild animals in relation to spread of disease. Study relationship of infection to abortion in cows. The applicability of sero-diagnostic methods will be explored. Determine whether the viral agents of this group can be detected in cell cultures or in frozen tissue sections using fluorescent antibody techniques.

A shift in the nature of investigational work on mastitis to study the oxidation-reduction potentials of milk at which lactenin is inactivated to determine if lactenin may be active in the udder, and influence growth of some organisms causing mastitis. Investigate the aspiration of bacteria into the teat sinus during mechanical milking. Evaluate applications of disinfectant ointments to teat ends subsequent to milking for reducing udder infections. Determine the possibility of the introduction of bacteria into the teat cistern during machine milking process. Determine both the minimum level of leukocytes that is protective against various dose levels of Aerobacter aerogenes, and the relationship between dose size and elapsed time for the appearance of clinical signs of mastitis. Ascertain the levels of catalase enzyme in the various kinds of leukocytes as a means of clarifying the disagreement that occurs at times in the California mastitis test and catalase activity. Conduct trials to test if toxin(s) are elaborated by the Aerobacter aerogenes used in present trials. Also investigate capability of such toxin(s) of producing a clinical response when introduced into the udder.

Studies are continuing of bacterial or viral agents causing respiratory disease (shipping fever) in laboratory animals. Basic determinations on the nutrition and metabolism of the Pasteurella organisms as a prerequisite to studies on the biochemistry of infection and its development. Transmission studies and course of disease in nature.

Evaluation will continue of the medium for isolation and identification of field strains of leptospira. Application of fluorescent antibody technique for a diagnostic aid. Study of antigenic relationship between Leptospira and the Shigella organisms.



The research work on epizootic bovine abortion will be continued but some variation in the study of this newer disease may be found advisable. Determinations as to whether abortion can be induced by the oral or nasal administration of EBA virus. Determine whether cows recovered from infection with the EBA virus are refractory to abortion when challenged with virulent virus. Investigate by field trials whether multiple injections of an inactivated EBA virus vaccine preparation will confer immunity to abortion. New work on this project will be to find out by epidemiological studies whether the EBA virus is tick-transmitted and whether the ticks are the reservoirs of the virus in nature.

The investigation on the causes for infertility in cattle, other than from vibriosis or trichomoniasis will be continued. Indications are that the conception rate in bulls may drop from 70 percent to 40 percent without a known cause. Sixty percent of the fetuses examined show no cause for the abortion.

The moving of the research work on foot rot from Beltsville to Ames, Iowa, and the lack of personnel and completed facilities necessitated the delay in starting work on foot rot at the new location. Research is to be resumed.

The delay in starting work on keratitis (pink eye) has been due to the moving of research on infectious diseases from Beltsville to Ames, Iowa, and to the incompleteness of facilities at the Ames Laboratory. This work is scheduled for the current fiscal year.

### 3. Problems Requiring New or Additional Research

#### Paratuberculosis (Johne's disease)

The extremely long period of incubation (one year or longer) of this disease and the apparent temporary improvement periods shown by the affected animal tend to delay early detection of infection. Improved procedures are needed for preparation of specific test agents, for isolation of the causative organism and the development of an effective immunizing agent.

#### Tuberculosis

The apparent increase in the number of reactor cattle to the tuberculin test that are classed as no-gross-lesion (NGL) cases raises questions: (1) Are the NGL reactors infected with Mycobacterium bovis, a new type of Mycobacterium bovis, or atypical mycobacteria? (2) Are factors other than mycobacteria causing a sensitization of cattle to tuberculin? Research is definitely needed on the characterization and classification of antigenically related mycobacteria and the role of sensitizing agents, if found to exist, to tuberculin.

#### Mastitis

This has been cited as a disease of great economic importance and recommended for expanded research by: Dairy Research and Marketing Advisory Committee, 1960; Livestock Research and Marketing Advisory Committee, 1961; and National Association of State Departments of Agriculture at the 1960 meeting of the USLSA.



Leptospirosis

The infection of beef and dairy cattle with leptospira results in heavy annual losses to the industry due to the loss of condition, abortions, and decreased production of milk. At least 5 serotypes of leptospira have been isolated from cattle. Leptospirosis presently appears to be not amenable to eradication due to the widespread occurrence of several serotypes in both domestic and wild animals. More basic research is needed on development of more specific diagnostic tests, the characteristics of the different serotypes and study on immunizing agents.



MISCELLANEOUS INFECTIOUS AND NON-INFECTIOUS  
DISEASES OF ANIMALS

1. Program Changes in Fiscal Year 1963

Professional Man-Years	F.Y. 1962 Base	Changes in F.Y. 1963
Incidence and pathology of tumors	1.0	
Vesicular stomatitis	1.0	+2.0 <u>1/</u>
Components of normal and immune serum	1.0	
Bloat in ruminants	4.5 <u>2/</u>	+2.0 <u>3/</u>
Preparedness for diagnosis of foreign animal diseases	2.7 <u>4/</u>	+1.5 <u>5/</u>
Toxicology and pathology related to insecticides	2.5	
Biochemical effects of agricultural chemicals	0.9 <u>6/</u>	
Detoxication mechanisms in cattle and sheep	0.5	
Cytological responses to anti- parasitic and other agricultural chemicals	0.5	
Poisoning by plants	1.1 <u>7/</u>	
Toxicity of herbicides and herbicide- treated plants for domestic animals	1.0	
Alleviators and diagnostic tests for plant poisoning	1.0	
The susceptibility of wild animals to foot-and-mouth disease		+0.5
Total	17.7	+6.0

- 1/ An epizootiologist and an immunologist at Ames, Iowa, to work on vesicular stomatitis.
- 2/ Includes cooperative agreements with California, Maryland, Mississippi, and Wisconsin Agricultural Experiment Stations and the New York State Veterinary College at Cornell University.
- 3/ A biochemist and a pathologist to work on bloat at Ames, Iowa.
- 4/ Includes cooperative agreement with the New York State Veterinary College at Cornell University.
- 5/ Shift in program within existing funds.
- 6/ Includes cooperative agreement with the Stephen F. Austin College at Nacogdoches, Texas.
- 7/ Includes cooperative agreement with Utah Agricultural Experiment Station.



## 2. Plans for Use of Current Resources through Fiscal Year 1964

Basic and applied research will be continued along the lines reported under progress in the thirteen subheadings under miscellaneous infectious and non-infectious diseases of animals which includes: (1) diseases such as vesicular stomatitis, which affects cattle, swine, horses, and man; (2) poisoning by various plants which differ in toxicity according to local conditions and affect different species of animals in various ways; (3) agricultural chemicals such as pesticides and herbicides which may produce poisoning in animals, especially if not properly used, and may also leave dangerous residues in the soil, feed, or animal body; (4) tumors, including cancer, which affect all species of animals; (5) bloat, a common, serious condition in cattle and sheep. Radioactive carbon-14 and phosphorus-32 will be used as isotopic labels for insecticides to determine their deposition on hair and wool and their penetration through skin and mucous membranes.

## 3. Problems Requiring New or Additional Research

### Vesicular Stomatitis

This disease is important not only because of its economic effects on cattle, swine, and horses but also because of its close similarity to foot-and-mouth disease. Additional basic research is needed on this disease to implement desired studies on reservoirs of vesicular stomatitis virus and spread of the disease.

### Bloat in Ruminants

A biochemist and a pathologist should be added at Ames, Iowa, to supplement the basic research considered necessary on the complexes of bloat (ruminant indigestion, metabolism, toxicology) in the broad field of physiopathology. This would make possible evaluation of normal and abnormal reactions in cattle and sheep connected with digestive, circulatory, and respiratory mechanisms in relation to the bloat-indigestion-metabolic complex. It would also afford needed study of the components in the feed of cattle and sheep that cause indigestion, bloat, and metabolic disorders resulting from both feed and microflora of the rumen.

### Preparedness for Diagnosis of Foreign Diseases

Research should be expanded on the development of diagnostic techniques and practical laboratory procedures for rapid, accurate diagnosis of additional foreign animal diseases and for conducting research aimed at improvement of existing techniques and development of new procedures for diagnosis.

### Susceptibility of Wild Animals to Foot-and-Mouth Disease

This should also be given increased study.



## FOOT-AND-MOUTH AND OTHER EXOTIC DISEASES OF CATTLE

## 1. Program Changes in Fiscal Year 1963

Professional Man-years	F.Y. 1962 Base	Changes in F.Y. 1963
Pathological investigations of foot-and-mouth disease in cattle	1.0	
Fluorescent antibody techniques	1.0	
Diagnostic investigations	3.0	
Susceptibility of cell lines	0.5	-0.5 <u>2/</u>
Production and maintenance of standardized reference stock of virus and homologous antisera	2.3	
Carrier state in convalescent animals	0.5	
Parasites in transmission of foot-and-mouth disease virus	0.5	-0.5 <u>3/</u>
Foot-and-mouth disease vaccines	4.1 <u>1/</u>	-1.0 <u>4/</u>
Antigenic variations of foot-and-mouth disease virus	1.0	
Production of foot-and-mouth disease antibody <u>in vitro</u>	0.5	
Immune response to various types and subtypes of foot-and-mouth disease virus	1.5	
Quantity production of foot-and-mouth disease virus in tissue culture	2.0	
Micro-cinematography of infected cells	0.5	
Pure stable lines of culture cells	0.5	+1.0 <u>2/3/</u>
Purification of foot-and-mouth disease virus	2.0	
Chemical and physical characterization of foot-and-mouth disease virus	1.0	
Interaction between foot-and-mouth disease virus molecules and host cells	1.0	
Genetic biochemistry of foot-and-mouth disease virus	1.0	
Effects of chemical and physical environments on foot-and-mouth disease virus	1.0	
Preservation of foot-and-mouth disease virus	1.0	
Rinderpest	2.5	-2.0 <u>5/</u>
Transmission of foot-and-mouth disease virus in semen	1.5	
Survival of foot-and-mouth disease virus in meat and meat products	2.0	
Susceptibility of wild species to foot-and-mouth disease	0.5	
Adaptation of foot-and-mouth disease virus to poultry and embryonating chicken eggs	1.0	
Pan American FMD Center, Rio de Janeiro, Brazil		+1.0 <u>4/</u>
Totals	33.4	-2.0



- 1/ Includes 0.6 PMY supplementing the work by field study of vaccinated cattle in the Netherlands.
- 2/ Half of one scientist's time at Plum Island shifted from work on susceptibility of cell lines to work on pure stable lines of culture cells.
- 3/ Half of one scientist's time at Plum Island shifted from work on parasites in transmission of FMD virus to pure stable lines of cell culture.
- 4/ One scientist transferred from work on foot-and-mouth disease vaccine at Plum Island to the Pan-American Foot-and-Mouth Disease Center, Rio de Janeiro, Brazil, through cooperative agreement, for work on duration of immunity.
- 5/ Two scientists shifted from work on Rinderpest at Plum Island to work on foot-and-mouth disease in swine at Plum Island.

It is anticipated that some realignments of scientists and revisions of current projects will be made, through necessity, in order to increase emphasis on foot-and-mouth disease problems that may arise and that are considered extremely vital to the program.

## 2. Plans for Use of Current Resources through F.Y. 1964

In pursuing pathological investigations of foot-and-mouth disease in cattle, study on frequency occurrence and nature of atypical (nonvesicular) lesions of foot-and-mouth disease in cattle is scheduled for completion.

Determinations are to be continued on the efficacy of fluorescent antibody technique in detecting foot-and-mouth disease virus antibodies in cattle sera.

In diagnostic investigations of foreign animal diseases--confirm that response of adult swine to rinderpest virus is subclinical; evaluate significance of gross and microscopic lesions in pigs experimentally infected with rinderpest virus; divert work to a study of response of sheep to artificial inoculation of rinderpest virus; develop reference sera and antigens for African swine fever; determine antigenic and pathologic differences between the viruses of hog cholera and African swine fever.

Continue conducting comparative tests of oil and aluminum-hydroxide adjuvants for improved foot-and-mouth disease vaccine.

Continue study of factors influencing complement-fixing activity of antibody; correlate studies with neutralizing and precipitating activity of antibodies produced by infection and immunization; develop tests for antigenic analysis of variations of FMDV.

The work on immune response of cattle to FMDV is scheduled for completion. Study the serum and colostrum antibody by serological methods; test animals periodically to determine duration of their immunity.

Research will continue on quantity production of FMDV in tissue culture until adequate information has been developed.

Work will continue on microcinematography of infected cells to determine effect on FMDV of passage through numerous cycles of regrowth in tissue culture; determine duration of infection in recovered cultures; studies of cell survival with other vesicular disease viruses; studies of cytopathic effects of FMDV and rinderpest virus on mitochondria of cells.



Work will continue on pure cell lines of culture cells to establish new cell lines and cell strains; screening cell lines and cell strains established to determine their susceptibility to FMDV.

Work will continue on purification of FMDV until at least 95% purity can be produced routinely; work on all phases of purification and concentration process will be pursued.

Chemical and physical characterization of FMDV is a new phase of study which will involve development of ultracentrifuge techniques for purification of FMDV and additional chemical studies of purified virus.

A shift of emphasis on the interaction between FMDV molecules and host cells will be made. Studies are to be conducted on the ultrathin section work and the intracellular synthesis of virus and virus components.

Study will continue of the primary and secondary structure of FMDV-RNA (ribonucleic acid) and of its chemical reactivity, especially with formaldehyde, in the genetic biochemistry of FMDV.

Work on effects of chemical and physical environments of FMDV will involve a new search for a toxin thought to be associated with FMDV. Work will continue on Genetron, also in effects of temperature and humidity on dried virus.

The work on preservation of FMDV will continue in drying of virus, viral vaccines, and antisera in bulk (500 ml.).

Complete studies on serological relationship between rinderpest, measles, and canine distemper viruses; determine exposure time and temperature needed to inactivate rinderpest virus with ethylene oxide. Measure the antigenicity, pathogenicity, and stability of higher tissue culture passages of attenuated rinderpest virus. Complete studies on infectious pustular vaginitis, bovine rhinotracheitis, and rinderpest viruses. Complete preparations of antisera to the soluble and virus fraction of tissue-culture rinderpest virus.

Studies will be expanded on transmission of FMDV in semen to determine by infecting bulls and other susceptible male animals with FMDV whether virus is present in the male reproductive system, semen, urine, and tissue. Determine if infection with FMDV via the female bovine and other animal reproductive tracts can be accomplished.

In studies of survival of FMDV in meat and meat byproducts, work will continue on stored lymph nodes taken from animals during the early stages of infection. Investigate possibility of virus survival in endocrine glands, blood, and body fluids.

Studies will be continued on susceptibility of wild species to FMD using birds, reptiles, and additional mammals.

Preliminary work is underway on adaptation of FMDV to poultry and embryonating chicken eggs.



The work will be continued on biological mechanisms of natural resistance and susceptibility to FMDV. The effects of such factors as repeated pregnancy and interrupted and prolonged lactation of mice to FMDV will be determined. The relative abilities of cells from resistant and susceptible animals to support virus multiplication in vitro and the effect of virus on these cells is to be investigated.

### 3. Problems Requiring New or Additional Research

No additions to the technical staff are proposed within the limitations of existing facilities.

Realignments of technical staff will be made to increase the effort on FMD of swine, immunological investigations, African swine fever, and transmission of FMD through semen.



## PARASITES AND PARASITIC DISEASES OF CATTLE

## 1. Program Changes in F. Y. 1963

Professional Man-years	F. Y. 1962 Base	Changes in F.Y. 1963	-
Acquisition of parasites from pasture	1.0	-1.0 <u>1/</u>	
Influence of diet and nutrition of cattle on roundworm parasitism	1.0		
Artificial propagation of protozoan parasites	1.0		
Ecology and immunology of lungworms	1.0		
Anaplasmosis	4.0		
Ecological factors influencing nematode development	1.1 <u>6/</u>		
Mixed helminth infections	2.0	-2.0 <u>2/</u>	
Host-parasite relationships of intestinal worms Cooperia spp.		+2.0 <u>2/</u>	
Effect of pasture mixtures and pasture management on control of internal parasites	1.5		
Host-parasite relationship of coccidia	1.0		
Winter coccidiosis (bloody scours)	1.1 <u>3/</u>	-1.0	
Trichomonad parasites		+1.0 <u>4/</u>	
Clinical and physiological aspects of roundworm	0.1 <u>5/</u>		
Totals	14.8	-1.0	

- 1/ Work was discontinued on acquisition of parasites from pasture and one scientist shifted to work on epizootological and ecological investigations of the internal parasites of grazing cattle.
- 2/ Work on mixed helminth infections was discontinued. The two scientists were shifted to work on host-parasite relationships of intestinal worms Cooperia species.
- 3/ Includes one parasitologist at Logan, Utah, station and cooperative agreement with Montana.
- 4/ Includes one parasitologist shifted during 1962 from work on winter coccidiosis to trichomonad parasites.
- 5/ Includes cooperative agreement with Utah.
- 6/ Includes cooperative agreement with Kentucky.

## 2. Plans for Current Resources through Fiscal Year 1964.

Work was terminated on the study of acquisition of parasites from pastures.

Studies will continue on the influence of diet and nutrition of cattle on roundworm parasitism to determine under controlled conditions whether a grain supplement or a high protein diet reduces susceptibility to infection with roundworms or ameliorates the effects of the infections acquired. One of two groups of comparable calves will be fed hay ad libitum; the other will be fed a substantial grain or protein ration in addition to hay ad libitum. Feed intake will be determined. Half of each group will be given equal numbers of the same kinds of gastrointestinal nematode larvae. Studies will be made of weight and blood changes in the host and of worm-egg output. At the termination of the test period, the infected calves will be necropsied and their worm loads determined.



Trials will be made to propagate protozoan parasites by tissue culture techniques in the presence of active cells and tissues of the host, in order to observe and measure cytopathogenic effects, and to provide leads to the development of methods of procuring, isolating, and purifying immunologic and other substances useful in control.

Studies will be made to determine whether the bacterial flora of chickens provide probiotic or antibiotic substances for histomonads, as a preliminary step in developing an understanding of the problem of blackhead in chickens.

Isolations will be made of species and strains of bacteria which provide probiotic substances for the test organism, and determination of the nature and characteristics of these substances.

Studies will be made to ascertain whether the strain of test organism being employed has, through generations of association with mycostatin and other antibiotics, developed a nutritional requirement for these agents, and whether it is capable of developing a tolerance for dimetridazole, and if this tolerance is reversible.

Studies will be continued to develop a satisfactory method of propagating the nonpathogenic Histomonas wenrichi in artificial culture media and finally determine its antigenic value as an immunizing agent against the pathogenic strain H. meleagridis.

There is a possibility of not being in a position to continue the work on ecology and immunology of lungworms during the coming year. Consequently, the project may be terminated or revised later. The work, when started, would include studies on the bionomics of the free-living stages of the cattle lungworm and on the combined effects of infection with this parasite and with one or more species of gastrointestinal nematodes.

Anaplasmosis transmission studies with D. andersoni will be continued to gain more information regarding the possibility of transovarian transmission. Effort is being made to establish a laboratory colony of D. occidentalis. It is planned to compare the relative efficiency of these two ticks as experimental vectors of anaplasmosis. Electron microscopic and immunofluorescent studies on cells and tissues infected with the causative agent of anaplasmosis will be continued. Serological studies will be continued comparing the efficiency of the CF and CA testing methods. Plans are to determine whether natural infection with anaplasmosis will result in the production of a precipitating antibody. Work will be continued on field studies on the prevention of anaplasmosis transmission by antibiotic feeding; the development of an anaplasmosis-free herd from an infected herd; the effect of the disease on milk production, and the importance of the Rocky Mountain wood tick in natural transmission of the disease.

The study will be continued on the ecological factors influencing nematode development and of the effect of temperature at which larvae of Trichostrongylus axei and T. colubriformis are cultured and their infectivity in rabbits and guinea pigs.

Tests will be continued on the use of the viable spores of Bacillus thuringiensis var. thuringiensis as a biological control of the free-living stages of nematodes of ruminants. In addition, the crystalliferous material will be given to animals as a feed additive.



Investigations are to be conducted on effects of Escherichia coli on the development of the preparasitic stages of ruminant nematodes.

Work will be done on the studies of the ecology of the free-living stages of various cattle nematodes. The effects of different factors, such as type of soil, temperature, humidity, and light intensity on the survival and horizontal and vertical migration of the third-stage larvae will be continued. The effect of different species of grasses common in Georgia on the migration and survival of the larvae will be pursued.

Studies will be continued on the effect of pasture mixture and pasture management on the control of internal parasites of beef calves, at the Georgia Experiment Station, to determine in part the heritability of some important traits of beef cattle. IBM records will be kept on the sire, dam, weight of calves, carcass quality, and parasite population of those animals used in

Rotation of steers on winter pasture will be studied for an additional three-year period at the Georgia Experiment Station, in an effort to determine the relationship between stocking rates and rotational grazing in control of internal parasites. Three plots will be planted with winter temporary forage. Two of the plots will be stocked with the same number of animals and will maintain the same stocking rate during the grazing season, but Group II will be rotationally grazed on a four-way rotation system. Group III will carry a considerably heavier stocking rate than the other two pastures and will also be grazed rotationally on a four-way system. Twelve animals from each group will be slaughtered for recovery of parasites.

Research will continue on the investigations of the host-parasite relationships of coccidial parasites of cattle to obtain various tissues containing different endogenous stages of coccidia of cattle in order to make histochemical analyses of these parasites while in the host tissues. An effort will be made to obtain excysted sporozoites of different species of coccidia of cattle for making a comparison of these bodies while they are still alive and after they are stained with various histochemical methods.

In the comparative studies on the host-parasite relationships of intestinal worms, Cooperia spp. in cattle, tissues will be obtained from calves necropsied in the course of the life history study of the intestinal worms, Cooperia pectinati and C. oncophora, and will be sectioned, stained and studied to determine the extent of tissue involvement associated with the various stages of development in the life cycle of the worms.

Studies to determine the pathogenic effects of C. oncophora and C. pectinata will be replicated to obtain additional valid data and also to provide an opportunity to compare the infections simultaneously. Sheep will also be used in these studies. Sera recovered from calves used this year in C. pectinata pathogenicity studies will be analyzed electrophoretically and colorimetrically for changes in proteins, phosphorus, and chlorides. Attempts will be made to gather conclusive evidence of hybridization between C. oncophora and C. pectinata.

The work on clinical and physiological aspects of roundworm parasitism in cattle will be continued along the same basic plans as were followed last year under the cooperative agreement with California.



The plan of study on bovine coccidiosis to be done under the cooperative agreement with Montana will include: the role of environmental and nutritional factors predisposing calves to winter coccidiosis, the variation in the susceptibility of calves to experimental infection with Eimeria zurnii, and the physiological changes in calves infected with the ordinary "winter" and convulsive forms of coccidiosis.

Investigate the excystation process and the pathway of penetration of sporozoites of E. bovis into the intestinal wall, and the earliest stages of development of the schizont, as yet unknown; compare these in immunized and nonimmunized calves.

In work on the life cycle of E. ellipsoidalis calves will be killed as soon as they start discharging oocysts, about 10 days after inoculation, and mucosal scrapings examined for oocysts and gametocytes; tissue sections will be prepared using several different methods and examined for stages of this species. Another group of calves will then be inoculated and killed at 0, 6, 4, and 2 days after inoculation in order to investigate the earlier stages of development. Similar methods will be used for E. auburnensis except that the first interval used will be about 14 days.

The work on the blood changes in calves experimentally infected with Ostertagia ostertagi will be continued.

Studies will be continued on the trichomonads of the bovine digestive tract with emphasis upon use of clone cultures and study of protargol-stained specimens. The morphology of the pentatrichomonad will be compared with that of Pentatrichomonas hominis, using cultures obtained from Samuels and Twohy. The tritrichomonad of the cecum will be studied as soon as it can be obtained in culture. An attempt will also be made to find and redescribe a trichomonad-like flagellate in the rumen in order to clarify the confused issue which is reported in the literature. Additional experiments will be performed with the cecal isolation technique, using a rubber stopper to aid in completely isolating the cecum, and using the method of severing the cecum so as to effectively isolate it. Such experiments, together with those performed, should provide information concerning the importance of local immunity as compared with systemic or humoral immunity against this species of parasite.

An attempt will be made to demonstrate by laboratory procedures, antibodies against Eimeria bovis in serum and tissue extracts of immunized calves.

New phases of work along projected lines will be undertaken during 1963. They are: (1) This project is concerned with epizootiological-ecological investigations of the internal parasites of grazing cattle. In view of the recent move to BPL and the lack of suitable pastures for immediate use in this project, some studies are anticipated involving zero grazing (feeding of fresh grasses or legumes to calves maintained in a barn) and also involving the recovery and concentration of parasite larvae from small areas of parasite-contaminated pasture. These pasture areas would be subjected to various methods of treatment to control or inhibit the development or survival of parasitic larvae. The concentrated material, recovered by ~~bar-~~mannization or washing and sedimentation, would be fed to parasite-free calves to determine the effectiveness of such control measures.



The six one-acre pastures presently available for this project are in such poor condition that they will be plowed and reseeded this fall and will be available for light grazing next spring. It is anticipated they can be used in a study on the effect of regular mowing in combination with resting of the pasture on the development and survival of parasitic larvae. Parasite-free calves will be rotated on these pastures to provide an index as to the effectiveness of these measures.

Recent work at this laboratory has indicated that the presence of ascorbic acid in the ration (natural or artificial) apparently assists the natural resistance of the rabbit to single experimental infections of Trichostrongylus axei, as evidenced by interference in the normal development of the parasite. This work is to be expanded to study host-parasite response in animals maintained on various biological test diets deficient or fortified with vitamins, minerals, proteins, carbohydrates, and fats.

Australian workers have found that the nutrition of sheep did not influence the establishment of T. colubriformis, but that it greatly influenced the severity of infection. The most severe infections resulted from single rather than repeated doses of larvae. When challenged four months after the initial infection, most of the sheep on a high-plane ration were resistant while most of those on a low-plane were susceptible. This experiment will be repeated at this laboratory using T. colubriformis in experimental rabbits.

Experiments will include determinations on the metabolic response of the rabbit host to different levels of parasitic infection while being maintained on a normal level of nutrition. Daily records are kept on weight gain, feed and water consumption, and fecal and urine output. The parasitic infections represent single and multiple doses of pure and mixed species of T. axei, T. colubriformis, T. calcaratus, and Obeliscoides cuniculi.

A line project description is being prepared to cover a histochemical study of Ostertagia ostertagi and of the pathology of infections of cattle by this nematode. Similar work may be done on other trichostrongylids to enable generalities to be drawn concerning the histochemistry of members of this economically important family. Work done in the preliminary investigations conducted during fiscal year 1962 will be extended to include more work with the techniques already used, thus obtaining a broader base of data. Other techniques will be used to confirm the results already obtained and to give information concerning other chemical substances. The histochemical pathology of other stages of infection, in addition to the 8-day infection by Ostertagia already investigated, will be studied.

### 3. Problems requiring New or Additional Research

The selection of problems and the design of the research studies on parasites of cattle have been made with the ultimate objective of accomplishing as much basic knowledge as possible through the utilization of available personnel and facilities. Many problems have been resolved to the benefit of the cattle industry; however, the recognized estimated losses attributed to parasitism, especially in young cattle, remain as a glaring example of the urgent need for additional research. The only recourse to the problems at present is to continue the studies on current research and to shift personnel when realignments are deemed advisable, for the overall work effort.



## MISCELLANEOUS PARASITES AND PARASITIC DISEASES

## 1. Program Changes in Fiscal Year 1963

For professional man-years devoted to this area of research, see page 75 of report entitled, "Cross-Species Animal Research."

## 2. Plans for Use of Current Resources through Fiscal Year 1964

Classification of parasites, maintenance of parasite collection, and maintenance and publication of author, subject, and host index catalogues are continuing long term projects.

Studies will be continued in the broad area of immunity to parasitic infections. Observations will be made on the degree of immunity developed in hosts infected with irradiated larvae, development of culture techniques will continue in order to study the growth requirements of nematodes, to provide larvae for the evaluation of host response to infection with specific stages, and to provide material for assay of metabolic products and secretions. Studies will also continue on the isolation and purification of antigens for use in serological and immunological procedures.

## 3. Problems Requiring New or Additional Research

Parasitism is a way of life that characterizes the majority of living things. Except for basic life processes, it is probably the commonest biological phenomenon. More than 50,000 kinds of animal parasites (i.e., parasites classified as animals as opposed to those classified as plants) are known. New varieties are being discovered and described at a rate of about 500 per year. Some devastating parasites, indigenous to foreign countries, threaten to surmount barriers imposed against them. Certain of these have already gained new footholds in livestock, poultry, and wildlife. Essential elements of procedure against parasites--established, exotic, or new--are accurate diagnosis, development of full knowledge about them and research on effective control measures. The primary requirement is development through research of up-to-date knowledge of classification and identification supported by a complete reference collection of parasites, including type specimens and familiarity with global research already done. Basic investigations of parasitisms as biological phenomena are involved, especially in host-parasite relations, immunology, serology, ultrastructure, and other aspects of diagnosis and control. The problem is to develop and maintain up-to-date methods of identification and the essential supporting reference collections, as well as complete parasitological information extracted from the world's scientific literature; investigate important phenomena and host-parasite systems not covered in specific host categories; and provide bases for detection and control that are adequate to meet existing and anticipated needs, through research on problems involving various parasites and hosts, including wild animals and birds important to agriculture.



## TREATMENT FOR REMOVAL OR CONTROL OF PARASITES OF DOMESTIC ANIMALS

### 1. Program Changes in Fiscal Year 1963

For professional man-years in this area, see page 60 of report entitled, "Cross-Species Animal Research."

### 2. Plans for Use of Current Resources through Fiscal Year 1964

Work in this area will continue along the same lines through fiscal year 1964.

### 3. Problems Requiring New or Additional Research

#### Basic Biology of Host-Parasite Relationships and Molecular Structure of Parasites

Work should be initiated to develop fundamental knowledge of host-parasite relationships and molecular structure of parasites of livestock and poultry for better understanding of the complex and changing interaction between these parasites and their hosts. Basic information of this kind may be expected to provide a foundation from which to explore approaches to prevention and control of parasitic infections by biological means such as immunization, for development of feasible therapeutic measures, and establishment of improved criteria for identification and differentiation of closely-related organisms of questionable systematic position. This should include studies of submicroscopic structure of organisms and possible correlation with their physiological functions, their pathological action, and the counteraction of chemicals used in therapy and prophylaxis. These studies of the phenomena of parasitism should be complemented by and correlated with intensive studies on life cycles, bionomics, geographical distribution, epizootiology, sources of infection, modes of transmission, and related aspects.

#### New Methods for Combating Parasites

New methods should be explored for combating parasites of livestock and poultry by biological means, including utilization of parasite secretions, excretions, and other fractions as immunizing substances. Extrinsic chemicals are currently the most powerful aids available, but continued use of these agents is jeopardized by potentially noxious residues in the flesh and organs of treated animals and products thereof. Moreover, evolution of parasite strains resistant to antiparasitic chemicals and the growing importance of parasitic diseases under changing agricultural practices emphasize a need to explore all possible approaches to control that may avoid or minimize reliance on chemicals. Development of preventive biologic products; formulation of special management practices; search for protective genetic factors (resistant hosts and avirulent or immunogenic parasite strains); discovery and utilization of natural predators; and searches for infectious diseases of parasites are representative of the areas to be explored.



Definition, Pathogenesis, and Pathology of Parasitic Diseases

Increased emphasis should be placed on development of means of definition of parasitic diseases of livestock and poultry, development of knowledge regarding pathogenesis, and familiarity with the pathology of these diseases in order to establish a more definitive concept of each parasitic disease entity. This includes identification of the specific ethiological agents, characterization of clinical symptoms, determinations of serological, chemical, and immunological patterns during various stages of the infection, demonstration of biochemical and physio-pathological changes in hosts during prodromal, syndromal, and postdromal stages of the diseases, and exact classification of gross and microscopic lesions. The work is visualized as a balanced, interdisciplinary program requiring cooperative effort from all investigational areas of the laboratory.



## DAIRY CATTLE INSECTS

## 1. Program Changes in Fiscal Year 1963:

Professional Man-years	F.Y. 1962 Base	Changes in: F.Y. 1963
Program leadership	0.8	
Basic biology, physiology and nutrition	5.6	
Insecticidal and cultural control	3.7	
Insecticide residue determinations	2.5	-0.2 <u>1/</u>
Biological control	0.3	
Insect sterility, attractants, and other new approaches to control	1.9	+0.2 <u>1/</u>
Evaluation of equipment for insect detection and control	0.3	
Insect vectors of diseases	0.7	
Totals	15.8	

1/ Shift at Beltsville, Md., from work on insecticide residue determinations to research on insect sterility and attractants.

## 2. Plans for Use of Current Resources through Fiscal Year 1964:

Basic and applied research on insects affecting dairy cattle will be continued at the current level. Basic studies will be made on the biology, ecology, genetics, physiology and nutrition of various pests, with primary emphasis on the screwworm, stable fly, face fly, horse flies, deer flies and mosquitoes. Basic studies will be continued on the nature of insect resistance to insecticides; on the absorption, metabolism, excretion and mode of action of insecticides in insects; and on factors affecting the duration of the effectiveness of insecticides on animals. Efforts will be continued to find and develop more effective contact and systemic insecticides and other materials and methods for controlling lice, ticks, screw-worms, horn flies, face flies, stable flies, horse flies, house flies, cattle grubs and horse bots. Special emphasis will be given to research on chemosterilants, attractants, repellents and other noninsecticidal approaches to control. Studies will be continued on biological control, with special attention to parasites and predators of the stable fly and face fly. Minor attention will be given to the possibilities of control of these flies and other pests with currently available pathogens. Studies will be continued to determine the levels of residues in tissues produced by certain insecticidal treatments, how long they persist, and how they may be minimized or completely avoided. The results of these studies will serve as a basis for developing use recommendations and restrictions. Research will be continued on bovine anaplasmosis in cooperation with the Animal Disease and Parasite Research Division and the Mississippi and Wyoming State Experiment Stations. These studies will involve direct and indirect transmission trials with various species of ticks and insects, the relationship of insects and ticks to incidence of anaplasmosis under natural conditions and methods of preventing transmission, with special attention to insecticides, repellents and antibiotics. Work will be continued in cooperation with the Agricultural Engineering Research Division to develop more efficient sprayers, dusters and other devices for use in livestock pest control. Studies will be continued in cooperation with that division and the Animal Husbandry Research Division on the development of physical and mechanical means of con-



trolling livestock pests, with special emphasis on radiant energy, factors involved in insect attraction or repellency to light and sound, and on traps and other mechanical devices.

### 3. Problems Requiring New or Additional Research.

#### Insects Affecting Dairy Cattle

Lice, ticks, and biting flies are serious pests of dairy cattle throughout the country. Heavy infestations of these pests adversely affect animal health and reduce milk yield. Research should be expanded to develop more effective contact insecticides to combat these pests, more efficient equipment for treating cattle with insecticides and ways and means of increasing insecticidal effectiveness and avoiding undesirable residues in milk. Expanded research is also needed to find systemic materials which when given at low levels in feed, water or salt would kill biting flies, lice, and ticks and prevent fly breeding in manure without producing residues in milk or animal tissues. Increased emphasis should be given to the development of insect attractants, chemosterilants, biological control with insect parasites, predators, and pathogens, and other noninsecticidal methods of control. There is an urgent need to develop repellents to protect dairy cattle from the face fly, stable fly, horse flies and deer flies, none of which can be controlled satisfactorily with currently available repellents or insecticides.

#### Control of the Face Fly

The face fly has spread rapidly from the New England States westward and southward into 32 States and is becoming an increasingly serious pest of cattle. Currently available insecticides and other methods of control have proved relatively ineffective against this new pest. Research should be expanded on the biology and ecology of this fly with the object of finding weak links in its life cycle which could be exploited for control. Special attention needs to be given to finding effective insecticides and ways of using them with maximum efficiency against the face fly. Research is especially needed to explore the possibilities of systemic materials which when given at low levels in feed, water or salt would prevent larval breeding in the manure without creating residues in tissues. Research now underway on attractants should be intensified in order to find substances which could be utilized in poison baits or with chemosterilants for control. Studies should be initiated to find insect pathogens, parasites and predators and ways of disseminating them for control of the immature stages of the face fly.

#### Cattle Grubs

Recent research has produced several systemic insecticides which will provide reasonably good control of cattle grubs, but these materials produce residues in milk and cannot be applied on lactating dairy cattle. Research should be expanded to find cheaper, safer, and more effective nonresidue forming systemics for the control of cattle grubs which now cost the cattle industry more than \$200 million dollars annually. Special emphasis should be given to the development of materials which would give control by any means of administration and which could be utilized on all classes of cattle in a nationwide eradication effort.



## Control of the Stable Fly or Dog Fly

The stable fly, or dog fly as it is known along the Gulf Coast of Florida, occurs throughout the country and is an especially serious pest of cattle in midwestern and northern states and along the Gulf Coast of Florida. In the midwestern and northern states this pest breeds prolifically in accumulations of manure, wet straw and silage on farms, whereas in the Gulf Coast area it breeds primarily in accumulations of seaweed along shore lines and in vegetable wastes on farms. Currently there are no satisfactory means of controlling this fly in either of these environments. Research on the stable fly in the Midwest should be expanded to develop more effective residual insecticides for the control of adult flies and larval breeding on farms. Expanded efforts are needed to find effective, long-lasting repellents to prevent the flies from biting cattle. Studies should be expanded to determine how to fully utilize several promising pupal parasites for control. Research should be initiated in the Gulf Coast area on the biology of the dog fly to find weak links in its life cycle which could be exploited for control. Studies should be initiated to develop insecticides, chemosterilants and other materials and efficient methods for the treatment of shoreline and farm accumulations of vegetation material in which the flies breed. New research is also needed to find parasites, predators and other biological means of controlling breeding under Gulf Coast conditions.

## Control of Ticks

In many sections of the country, ticks are the most important single pest of cattle. Heavy infestations of ticks reduce milk yield, damage hides, and cause unthriftiness in animals. They are also vectors of several important diseases of cattle. Research should be initiated on the biology and ecology of ticks in certain areas in order to determine the factors favoring their multiplication and to develop management procedures to minimize their multiplication. Current research should be expanded to develop more effective, longer-lasting, nonresidue-forming insecticides for the control of ticks on cattle. Research should also be undertaken on the possibilities of area control with insecticides, with special emphasis on materials that would not be hazardous to fish and wildlife or create undesirable residues on pastures.

## Insect Vectors of Livestock Diseases

Dairy cattle are subject to infection with diseases transmitted by insects and ticks which are detrimental to animal health and frequently cause heavy mortalities. A few species of ticks and biting flies are known to be vectors of certain diseases but the role of most insects and ticks in the transmission of cattle diseases has never been investigated. Research in cooperation with veterinary pathologists should be expanded to determine the role of various species of lice, biting flies and ticks in the transmission of important diseases and parasites, especially anaplasmosis, and to develop control procedures for proved vectors.

## Insecticide Residues

The use of insecticides is essential to minimize the detrimental effects of insect and tick infestations on cattle and thereby insure good animal health and maximum production of milk. However, the most effective insecticides create residues in milk and animal tissues and cannot be applied to



dairy cattle. Efforts should be expanded to find safe, effective and economical insecticides which will not create residues or affect the flavor or quality of milk or dairy products. Special research should be initiated to develop insecticides that are rapidly metabolized and are nontoxic.

#### Chemicals Affecting Life Processes

Recent research studies have shown that certain chemicals adversely affect growth and sexual development of insects. Small amounts of certain chemicals applied dermally or fed to adult insects cause sexual sterility of the insects. These preliminary results suggest that chemosterilants are a promising new approach to control and need to be thoroughly investigated for the practical control of flies and other pests. Increased emphasis should be on the search for safe materials and on methods of utilizing them safely and with maximum efficiency for the control of insect pests of cattle.



## EQUIPMENT AND STRUCTURES FOR PRODUCTION, FARM HANDLING, AND STORAGE

## 1. Program Changes in Fiscal Year 1963

Professional Man-years	F.Y. 1962 Base	Changes in F.Y. 1963
Dairy Cattle Equipment	3.4	
Electrical and Physical Control for Dairy Cattle Insects	0.8	+1.0 <sup>1/</sup>
Layouts, Equipment and Facilities for Increasing Efficiency of Dairy Operations	1.4	
Bio-engineering Studies of Dairy Cows	1.5	-0.1 <sup>2/</sup>
Totals	7.1	+0.9

<sup>1/</sup> One junior engineer added to fly control project at Beltsville.

<sup>2/</sup> Vacancy left unfilled to absorb increased operating costs.

## 2. Plans for Use of Current Resources through Fiscal Year 1964.

Dairy Cattle Equipment

Investigations will continue to develop simple and economical electric controls for automatic feed handling systems. Development of a current sensing control will be continued to regulate a top unloading silo unloader with sufficient accuracy to meter silage for blending with concentrate and chopped hay. A prototype track-mounted silage unloader for horizontal silos will be completed and evaluation tests begun. As soon as the unloader performs satisfactorily it will be integrated into a complete system for automatic removal and distribution of silage. Motor performance characteristics for top unloaders will include a study of 440-volt motors for unloaders.

Electrical and Physical Control for Dairy Cattle Insects

At Beltsville a laboratory to be used cooperatively by Agricultural Engineering, Animal Husbandry, and Entomology Research Divisions will be constructed and equipped. Investigations will be made on various physical and other nonchemical means of controlling flies in and around dairy barns. Engineering aspects of the studies will include evaluation of various physical attractants and developing effective physical methods for killing. Attractants such as light and other forms of radiation will be evaluated. Killing methods to be evaluated include improved electrocutor grids, r-f energy, and mechanical devices.

Layouts, Equipment and Facilities for Increasing Efficiency of Dairy Operations

These studies will continue through F.Y. 1964 at the same level of support as in F.Y. 1962. Attention will be devoted to layout, handling and equipment phases of livestock housing and feeding structures. At St. Paul,



Minnesota, work on the techniques of using models to study layouts is expected to be completed. Studies using models jointly with time standards in analyzing farmstead layout problems will be given more emphasis. Development of time standards for farmstead work elements will receive continued emphasis.

At Davis, California, time and travel studies on herringbone and pie-shaped corral layouts will be continued at about the same level. These studies are made as new facilities are built or remodeled and come to the attention of the project engineer.

#### Bio-engineering Studies of Dairy Cows

These studies will continue, but at a reduced level of support. At Columbia, Missouri, acclimation studies of lactating dairy cows to a stressing thermal environment will be replicated in the Psychroenergetic Laboratory. Studies to develop a field index of heat tolerance for dairy cows will continue. A portable 1-cow test chamber is being constructed for these studies. Radiation cooling effects on dry cows will also continue under study. A well insulated 24-cow stall barn has become available and plans to install air-conditioning to obtain data on whether milk production would be sustained during a hot Missouri summer are under consideration.

At Tifton, Georgia, studies to evaluate the effects of shade, fans, and spray on dairy cattle were suspended in September 1962, due to the need for reducing operating costs.

#### Plan Development

Development of typical plans for housing, feeding and handling structures and equipment for dairy cattle will continue at about the present level of support.

### 3. Problems Requiring New or Additional Research

#### Dairy Cattle Equipment

An economy based on dairy production requires the handling of considerable quantities of feed and waste at regular intervals. Electrified and automatically operated equipment lends itself to the performance of routine tasks such as the preparation and distribution of feed. The removal of silage, baled, chopped or wafered hay, concentrate preparation, metering and distribution at regular intervals may be accomplished with suitable equipment. Research should be expanded on improving and developing automatic controls and equipment for these routine tasks.

#### Need for Farm Electrification Research Center

The range of problems and questions needing study on the effects of electrical energy in its many forms on plants, seeds, animals and insects is wide and almost limitless. Electric energy may be the key to new approaches for controlling certain diseases and insects that plague fruits, vegetables, and other plants. The residue hazards created by present control methods



make research on this problem imperative. Systemized operations and automation on the farm need electronic controls yet to be developed. New approaches to refrigeration and other ways of preserving quality in agricultural products need to be studied. The potential use of X-ray, gamma ray, and r-f radiation in plant breeding and bacteriology should be more intensively investigated.

#### Reducing Time and Labor at the Farmstead

Improved layout, building arrangement, methods and equipment are needed on farmsteads to reduce excessive man-hour requirements, eliminate drudgery, and increase returns. Research in this area should be expanded with the aim of developing design criteria and principles having wide application in reducing time and labor at the farmstead. Integrated engineering, economic and husbandry research, using farm scale research farmsteads in the major farming areas, should be undertaken to develop and evaluate, under controlled management, alternative layouts, equipment, and automatic controls for integrated and automatized systems.

The problem is national in scope, involving operators of all types of livestock enterprises. Systems of milking and handling feed, bedding, manure, milk and animals would be compared in relation to equipment and structures required and scale of operation. The problem of wastes disposal appears particularly in need of effort to reduce drudgery and save time. Basic information would be developed to determine the merits of the types and arrangement of structures, equipment and management systems in terms of labor efficiency, performance of animals, quality of product, and performance of equipment and structures. Experimental structures and equipment would be considered expendable and materials and erection procedures based on limited experimental use. There is urgent need for this type of information by livestock producers, extension workers, manufacturers, and code making authorities.

#### Influence of Environmental Factors on Dairy Animals

Growth, health, fertility, production, feed consumption and heat and moisture dissipation of dairy animals are influenced by environmental factors such as temperature, humidity, wind, rain, radiation and light. Research to determine the nature and extent of these influences and their complicated interrelationships, particularly under conditions of stress, should be expanded to accelerate obtaining the basic data needed for design of shelters that will provide optimum environmental conditions in the most economical manner.

The expanded research program should include provision for constructing and staffing a central Controlled Environment Livestock Laboratory to be operated jointly by AE, AH and ADP in a multi-discipline approach to the problem. This laboratory is particularly needed to provide facilities for low temperature studies that have been impractical with most of the currently available research facilities. Support is needed immediately to develop design criteria for such a facility.



DAIRY PRODUCTS - CHEMICAL, PHYSICAL AND BACTERIOLOGICAL CHARACTERISTICS;  
DEVELOPMENT OF NEW AND IMPROVED PRODUCTS AND PROCESSING METHODS

1. Program Changes in Fiscal Year 1963

Professional Man-years	F.Y. 1962 Base	Changes in F.Y. 1963
<u>Chemical, Physical and Bacteriological Characteristics</u>		
Composition and physical properties of milk	0.5	
Isolation and structure of milk proteins	13.5	
Flavor components of milk; flavor stability	7.5	
Microbiology; dairy fermentation; cultured dairy products	2.5	
Control of spoilage organisms	1.0	
Enzymes in milk	1.0	
Allergens of milk	4.0	
Interaction of Milk Components	6.0	
<u>Development of New and Improved Products and Processing Methods</u>		
Dry whole milk and other dried milk products	30.5	
Improved processing of fluid milk	1.5	
Improved Cheeses and Cheese Technology	0.8	
Improved Concentrated milks	2.7	
Improved butter and milk fat products	1.2	
Removal of radionuclides from milk	9.5 <sup>1/</sup>	4.0 <sup>2/</sup> (4.0) <sup>2/</sup>
New and Improved Milk-containing food products	0.0	
Totals	82.2	16.0 <sup>3/</sup>

- <sup>1/</sup> Includes 4.0 professional man-years supported by Atomic Energy Commission  
<sup>2/</sup> Reflects funds anticipated from Public Health Service  
<sup>3/</sup> At the time that this report was prepared, determination of the distribution of this increased effort among the research lines (apart from removal of radionuclides from milk) had not been made.

2. Plans for Use of Current Resources through Fiscal Year 1964

Plans

The search for minor milk constituents which have major effects on the physical and chemical properties of milk products will be continued; better methods of detailed analysis for milk proteins will be sought and genetic factors involved in their synthesis in milk will be investigated. The current program on isolation and structure of milk proteins will be continued along with further studies on their interactions with each other and other milk components. Work will be continued on development of methods of analysis for individual components of milk which have to do with off-flavor; the carbonyls now being isolated from samples of milk fat will be examined for off-flavor which they produce when added to fresh milk. New and improved cultured milks and sour cream will be developed. Special equipment previously developed for



deodorizing and concentrating milk will be used in research to improve cottage cheese manufacture. Attempts will be made to produce a dry yoghurt culture which would be useful for making yoghurt in the home. Work will continue on the biochemical study of bacterial spores. Psychrophilic organisms responsible for spoilage of milk and cottage cheese during cold storage will be studied with the goal of prolonging the life of these products. Research on enzymes in milk and its products will be continued to the extent that available manpower permits. With the discovery of a single milk protein having antigenic properties greater progress in allergens of milk can be expected. Work will be continued to determine the fundamental changes which occur in dry milks during storage and result in a reduction in their acceptability. The recently developed method, called foam spray drying, will be applied to additional dairy products such as milks with intermediate composition between that of fluid whole milk and NFM, ice cream mixes, malted milk and cheese. Research will be carried out to prolong the storage stability of fluid milks, to improve cultured buttermilk and to study application of HTST sterilization to fluid milk. Work will continue on development of a ripened skim milk cheese which will have an attractive body and flavor and on improvement in the quality of ripened cheese through chemical, microbiological and enzymatic studies. Research will be continued and expanded on methods for improving the stability of concentrated milks during storage, with emphasis on (1) further improving the effectiveness of additives, especially polyphosphates, (2) basic chemical and physical reactions which are responsible for gelation and fat separation in concentrated milks during storage, (3) study of undesirable flavor changes in concentrated milks, and (4) research on chemical properties of the milk proteins and milk protein fractions. Research will be initiated to determine the factors responsible for deterioration of butter oil in storage; new and improved manufacturing procedures will be developed for anhydrous milk fat. To increase its utilization new and improved milk fat containing products will be developed. Laboratory work on removal of strontium 90 from milk will be continued and should be completed in this period. The Beltsville pilot plant will be automated, and operated to determine the practicality of the several processes developed in the laboratory. Commercial scale operations will be started with a fixed bed column system under a contract supported jointly by USDA and Public Health Service. Research will be initiated on practical methods for the removal of other radionuclides such as iodine 131, from milk. Research will be undertaken to develop new and improved foods from whey, skim milk and milk fat such as creamed foods, bakery and ice cream products.

### 3. Problems Requiring New or Additional Research

#### Composition and Physical Properties of Milk

Although the major components of milk were recognized and measured many years ago, there are some minor constituents which affect the properties of milk products far beyond the influence that might be expected from their small amount. It is almost certain that some of these have not yet been discovered. Basic research to identify these unknown factors and then to control those that lead to undesirable flavor or textural characteristics in milk products will contribute great benefit to the dairy industry. Suitable methods should be developed for determining the several proteins in individual milks; these methods should be applied in a survey of appropriate breeds and herds in cooperation with animal husbandry research units to clarify potential genetic correlations. The relationship between nucleic acid composition and structure should be studied, as well as the genetic control of synthesis of the two forms of beta-lactoglobulin, using physical chemical, biochemical and tissue culture techniques.



## Isolation and Structure of Milk Proteins

With the more recent tools and techniques of biochemistry more and more proteins are being isolated from milk in high purity; some formerly believed to be a single pure protein are now recognized as mixtures. A recently discovered one has antigenic and other interesting properties. Accelerated research on milk proteins is very likely to yield highly useful information that will aid in improvement of many dairy products. Studies of the mechanism of protein aggregations in milk should be extended. The current program on isolation of individual proteins of milk, and determination of their composition and detailed structure should be continued and expanded.

## Interaction of Milk Components

The major components of milk are lactose, milk fat, and a complex mixture of proteins of which caseins make up a major portion. Under suitable physical and chemical conditions some of these interact with each other to give a brown color, a coagulum, or other behavior, usually undesirable in a dairy product. To better understand these interactions, and where possible to prevent them from taking place, requires further research of a difficult type under the direction of superbly trained physical scientists.

## Flavor Components of Milk; Flavor Stability

The chemistry of undesirable flavors in milk and its products continues to receive widespread attention in the world's major milk-producing countries. Frequent discoveries, made possible by powerful new analytical tools, are clarifying our limited knowledge in this area. Much remains to be done. In addition coordinated research on a perhaps even more important, but scarcely touched field--the good flavors of milk and its products -- should be expanded also to isolate, identify and determine quantitatively the chemical substances responsible for those flavors which appeal to the consumer.

## Control of Spoilage Organisms

Basic information concerning physico-chemical characteristics responsible for the high heat-resistance of bacterial spores and biochemistry and physiology of spore germination is urgently needed by the dairy industry (and the food industry in general) as a basis for developing practical means for either blocking spore germination or converting spores into heat sensitive cells. Either of these two methods, but particularly the latter, would revolutionize food processing. It would make possible the sterilization of milk at pasteurization temperatures and thus eliminate the development of a cooked flavor which accompanies present high-temperature sterilization. The program should be expanded to include basic work on the psychrophilic bacteria, molds and yeasts causing spoilage in market milk, cottage cheese and ripened cheeses with the aim of developing effective and acceptable microbial inhibitors.

## Enzymes in Milk

A broad survey of the enzymes in milk should be undertaken. Variations of the major enzymes during the lactation cycle should be determined as well as individual and seasonal variations. Heat resistance and reactivation after heating of enzymes whose action might be related to flavor or stability changes should be studied. An attempt should be made to correlate the



presence of enzymes in milk with flavor and stability changes in milk prior to processing and during storage of dairy products. The deliberate use of enzymes to bring about desirable changes in milk or the components of milk should also be explored. The action of rennin on milk is still not completely understood, and deliberate modification of the components of milk by enzymes is a promising and almost completely unexplored field in the design of new and improved dairy products.

### Allergens of Milk

Recent isolation from cow's milk of a protein with strong antigenic properties furnishes an opportunity to expand basic research in this important field of milk and its public relations. Availability of this purified material makes possible new approaches to this complex problem; these should be pursued with increased facilities and manpower.

### Dry Whole Milk and Other Dried Milk Products

Although major improvements have occurred in dispersibility of nonfat dry milk and dry whole milk from recent research, flavor stability of dry whole milk under practical storage conditions still leaves much to be desired. For many years the industry has sought processing conditions or other means of stabilizing dry whole milk during storage. Inert gas packing has some preservative effect toward the development of oxidized flavor, but for 6 months freedom from oxidized flavor the oxygen content in the container must approach zero (less than 0.001%); with protection from oxidized flavor a distinct stale flavor still develops in about 6 months at 80° F. In spite of all these facts progress is encouraging enough to justify hope that further research will develop a dry whole milk with acceptable storage life. Solution of this problem would be a great contribution to the dairy industry and should result in a significant increase in whole milk consumption.

Instant nonfat dry milk can now be manufactured in one step with resultant savings in cost. A definite development program is needed to acquaint the dry milk industry with this new more economical process. Much whey is wasted partially for lack of a successful drying technique to make its transportation more economical. The new foam spray drying technique makes possible for the first time successful and economical conversion of cottage cheese whey to a powder. Research is urgently needed to discover and promote food uses for this nutritious material.

### Improved Processing of Fluid Milk

Market milks differing from whole milk in composition are sold today in some States. One of these is the product containing 2% milk fat and 10% NFS. This product is presently manufactured from partially skimmed milk and NFMS. In an improved manufacturing process whole milk is skimmed to a fat content such that on simultaneous pasteurization, deodorization and concentration to 10% NFS it will contain 2% fat. The same procedure, without concentration, is advantageous in processing regular fluid milk also. These techniques should be promoted in the dairy industry because appreciable savings and improvement in quality can be gained thereby.



## Improved Cheeses and Cheese Technology.

Improvement in the uniformity of cheese texture and flavor are highly desirable. Since these properties are primarily the result of microbial changes brought about in milk constituents, a greatly expanded program is needed on the metabolic processes of microorganisms and means to vary the metabolic products in favor of flavor enhancing compounds. Further research on improvement of quality, uniformity and yield of cottage cheese is needed to increase consumption of this valuable food. There is a need in the market place for a low fat cheese of good flavor and textural quality; a promising product has been made in the laboratory and this should be tested in the pilot plant before recommendation to the industry.

## Improved Concentrated Milks

Although improvements in certain characteristics of concentrated sterile milks have been achieved, other problems need more intensive research. Especially to be mentioned are the needs to study undesirable flavor changes in concentrated milks, particularly those prepared by the newer techniques, upon storage at room temperature, since these flavor changes are believed to arise from chemical reactions which are different from those concerned in flavor deterioration in other dairy products. Fundamental and exploratory chemical and physical research to discover concepts, principles and reactions leading to new processes for concentrated milks should be initiated.

## Improved Butter and Milk Fat Products

Annual butter consumption has decreased from 17.0 to 7.5 pounds per capita since 1940, and butter is an increasingly serious surplus problem; in the 1961-1962 marketing year the government purchased 435 million pounds at a cost of \$271 million. Although its cost in comparison with competing household spreads is a major factor in this situation, improvements in intensity and uniformity of that flavor which is primarily responsible for butter's consumer appeal would aid in maintaining and increasing its consumption; butter still ranks second in importance among dairy products. For consumption in foreign markets an anhydrous milk fat would have advantages over butter in stability. Investigations are needed to find conditions for preparation and packaging of milk fat with optimum properties for storage and use in foreign trade.

## Removal of Radionuclides from Milk

Since the advent of the atomic age radionuclides have appeared in our milk supply. Although their present concentration is not considered hazardous, the continuation of nuclear testing and the threat of nuclear war make it highly desirable to develop methods for the removal of radionuclides from milk in order to insure a safe milk supply. An ion exchange method for the removal of strontium 90 has progressed from the laboratory through the pilot plant and its feasibility on a commercial scale will be tested. More research is needed to test and evaluate proposed methods for the removal of the major and minor radioactive contaminants of milk. Since some milk processes are quite sensitive to the mineral balance in milk, the effect of radionuclide removal treatment on subsequent processing characteristics of milk should be investigated.



## New and Improved Milk Containing Food Products

Recent widespread adoption of the continuous process for baking bread is seriously reducing the use of NFDM in bread because of reported technical difficulties in the bakery when more than 1% NFDM is used; previously this was the biggest use for this highly nutritious product. In 1960 the Government purchased 852 million pounds out of a total production of 1,837 million pounds. If the use of 1% NFDM in bread instead of the former 3 to 4% becomes uniform, the Government under present practices will purchase an additional 200 million pounds at a cost of about \$30 million. The nutritional value of NFDM is not in dispute, and immediate research is imperative to find out how this product can be used in continuous bread-making at the 4% level or more.

Milk proteins have special properties that have potential usefulness in a variety of foods. Research should be initiated to develop methods capable of separating useful protein fractions from milk on a pilot scale. The special properties of such fractions could then be studied for use in food manufacture. Research should be conducted to improve the properties of conventional milk products to better adapt them to special food production uses, and investigations should be started to develop new milk-containing foods in the bakery, canned and dried foods areas.



## DAIRY PRODUCTS - MARKET QUALITY

## 1. Program Changes in Fiscal Year 1963.

Professional Man-years	F.Y. 1962 Base	Changes in <sup>1/</sup> F.Y. 1963
Program leadership	0.5	-0.2 <sup>2/</sup>
Objective measurement and evaluation of quality	1.5	
Basic biology and ecology	0.3	+0.2
Insecticide evaluation	1.0	-0.1
Insecticidal control	0.2	-0.2
Insecticide residue analysis		+0.4
Insect-resistant packaging	0.5	-0.1
Total	4.0	0.0

<sup>1/</sup> See Section 2 below for explanation of shifts in emphasis.

<sup>2/</sup> Transferred to research on insects attacking deciduous fruit and tree nuts.

## 2. Plans for Use of Current Resources through Fiscal Year 1964

Studies of chromatographic cleanup techniques for chlorinated insecticides will be continued; methods of extracting these insecticides from milk will also be studied. Work will be reinitiated on staining techniques for the direct microscopic count and a project will be started on a keeping quality test for butter.

The effects of processing treatments on determination of protein by dye-binding procedures will be evaluated by the contractor, completing phase 1 of the work. After this, the contractor will proceed with phase 2, under the supervision of ERS, which is concerned with the economic aspects of the problem.

The studies on the pretreatment of concrete surfaces to prevent the breakdown of organic phosphate insecticide residues, and on the toxicity of methyl bromide to the different stages of the cheese mite will be terminated. The evaluation of residual insecticide treatment for controlling insects in dry milk plants will be discontinued until more promising treatments are discovered in the laboratory evaluation tests. Research will be continued on the development of insect-resistant packages with emphasis on fiberboard containers; and on the sex attractancy of dermestids with the future emphasis being placed on the isolation and synthesis of the sex attractant. Biological studies on dermestids and mites will be continued on a limited basis.

## 3. Problems Requiring New or Additional Research

Objective Measurement for Pesticide Residues in Milk

Present regulations require that milk and other dairy products be completely free of pesticide residues. Available methods for the analysis of such residues are impractical for use in marketing. Research should be expanded on the development of rapid screening tests for pesticide residues in milk and other dairy products.



### Moisture Loss in Butter During Marketing

Variations in the amount of moisture lost during printing of different lots of butter may cause weight shortages in retail prints. Loss of moisture may occur also from "weepage" after the prints are packaged and enter the marketing channels. Research should be initiated to develop methods for predicting the amount of moisture which will be lost so that appropriate adjustments can be made in the printing operation and/or in the market handling to prevent such losses. A study of the microstructure of butter as related to moisture loss should yield information which can serve as a basis for the development of such methods. These techniques will be of direct benefit to packagers and distributors of butter.

### Objective Measurement of Market Quality of Dairy Products

There is constant need in the dairy industry for rapid, accurate, and practical methods for measuring important quality factors in a variety of dairy products. Research should be expanded to develop: (1) Improved tests for bacterial condition of nonfat dry milk; (2) objective tests for the keeping quality of butter; and (3) new tests for the market quality of cottage cheese.

### Protection of Dairy Products Against Insects and Mites

Insect infestation of nonfat dry milk during processing, storage and transportation is a serious problem to the dry milk industry and to the Government in its price support and school lunch programs; mite infestation during curing and storage adversely affects the quality of cheese. To develop effective control and preventive measures that leave no undesirable chemical residues, research should be expanded on (1) basic studies on the biology and ecology of dairy-product pests, (2) basic and applied studies on the development of more effective materials and uses of pesticides so that a minimum amount will be required to protect dairy products while in processing, storage, and transportation facilities, and (3) the development of insect-resistant packages. Research work should be initiated on the development of nonchemical methods of preventing or controlling dairy-product insects.

### Obnoxious Insects in Food Processing and Handling Areas

Insects such as flies, roaches, and ants are not only obnoxious in food processing and handling areas but contaminate food with filth and disease. Research has been conducted on the control of these pests in the home and on the farm, but little or no work has been done in controlling these insects where food is processed, handled, or sold. Research is needed in adapting available control methods or developing new ones that can be used effectively without producing pesticide residue contamination of the food or the food processing and handling equipment.



DAIRY PRODUCTS - MARKETING FACILITIES,  
EQUIPMENT AND METHODS

1. Program Changes in Fiscal Year 1963

Professional Man-years	F.Y. 1962 Base	Changes in F.Y. 1963
Program leadership	0.4	
Layouts and operating criteria for automating dairy plants	0.7	-0.2 <sup>1/</sup>
Totals	1.1	-0.2

<sup>1/</sup> Amendment to contract which extends "Period of Contract" from two years to three years reduces rate of annual expenditures from 0.7 man-year to 0.5 man-year.

2. Plans for Use of Current Resources through Fiscal Year 1964

Research to develop improved layouts and operating criteria for fluid milk, ice cream, and cheese plants shifting to the automation of mechanized operations will be continued. The phase of work dealing with special purpose plants, multi-purpose plants, ice cream plants, and cottage and cream cheese, and cultured milk and cream are scheduled for completion during the year. Greater emphasis also will be placed on the phase dealing with cheddar cheese and sweet cream butter and dried nonfat milk plants. The work is being performed under contract and is scheduled for completion in July 1963. However, it is anticipated that final corrections and editing of the work will not be completed until January 1, 1964. With the resources available, it is planned to initiate work on new processes and equipment for the mechanization and automation of dairy plants during the first part of the fiscal year 1964.

3. Problems Requiring New or Additional Research

Possible Increases in Plant Efficiencies through Optimum Utilization of Automated Equipment

Remotely-operated valves; automatic controls, and highly mechanized packaging and handling equipment for dairy product plants require a considerably greater investment than conventional-type equipment. As a result, plant efficiency depends in part on the optimum use of equipment - the relative advantages of operating equipment at various speeds, (or fraction of rated equipment capacity) and of operating one or more shifts each day. Research on automated dairy product plants should be initiated to provide data on optimum use of automated equipment to maximize plant operating efficiency. Research should be expanded to develop a fully mechanized record and report system for all types of dairy product plants to increase plant operating efficiency.



Developing a Mechanized Records and Report System for Dairy Plants

The amount of record keeping and calculations involved in maintaining an adequate system of reports in dairy product plants is comparatively large. In fact, the job is so great that some plants fail to maintain the type of records and reports needed for a sound management program. Many systems that are maintained are kept manually with a relatively high labor cost. Research to determine guides as to the kinds of records needed by fluid milk plants for a sound management program has been completed.



## CONSUMER PACKAGES AND SHIPPING CONTAINERS

## 1. Program Changes in Fiscal Year 1963

Professional Man-years	F.Y. 1962 Base	Changes in F.Y. 1963
Dairy products:		
Consumer packages and master containers- bulk shipping containers	0.8	-0.6 <u>1/</u>

- 1/ Most of manpower will be assigned, at least temporarily, to work on improved containers for domestic and foreign shipments by air and sea, and to development of an improved bale package for cotton.

## 2. Plans for Use of Current Resources through Fiscal Year 1964

Dairy Products

With field work almost completed on evaluation of single-service 5-gallon fiberboard boxes with film liners for institutional milk served from dispenser units, 0.6 professional man-year will be divided between research to develop an improved bale package for cotton and to develop consumer packages and shipping containers for domestic and foreign air shipments of agricultural products. A report on findings in the milk container study will be prepared.

## 3. Problems Requiring New or Additional Research

Milk or Milk Products

Increasing marketing costs - particularly of packaging and delivery - are of growing concern to producers, distributors, and consumers of milk. Expanded research is needed in the evaluation of new and improved milk containers that (1) are less expensive; (2) require less costly equipment, less power, less space, and less labor to fill and move to storage; (3) are more durable and easier to deliver; (4) are suitable and more convenient at point of sale or use; and (5) will stimulate consumer acceptance and increase consumption.



## ECONOMICS OF MARKETING

## 1. Program Changes during Fiscal Year 1963

Professional Man-years	F.Y. 1962 Base	Changes in F.Y. 1963
Distribution programs	0.6	-0.5
Market Potentials for New Products and New Uses	0.7	+1.0
Merchandising and Promotion	1.3 <u>1/</u>	+0.5
Economics of Product Quality	1.3	
Marketing Margins, Costs, and Efficiency:	3.8	+0.7 <u>2/</u>
Market Structure, Practices and Competition	5.0	+1.3 <u>3/</u>
Totals	12.7	+3.0

1/ Includes contracts.

2/ Shift from another area in marketing economics.

3/ Shifts from another area in marketing economics.

## 2. Plans for Use of Current Resources through Fiscal Year 1964

Special Milk Program

Research relating to the Special Milk Program will be developed from data obtained from surveys of school food services and the market for food in schools and represents a coordinated effort with comparable completion dates to that previously specified.

Low-fat Milk

Research on low-fat milk will be continued to more fully appraise its distribution pattern and through detailed market studies its rate of sales and impact on other milk products will be determined. Work will be initiated on dried whole milk in its present state of technology to ascertain through product testing those outlets where its commercialization would be most probable and to provide guides for further developmental research on its properties. (See problems requiring additional research.)

Merchandising and Promotion

A study of merchandising and promotional practices employed by restaurants for dairy products is nearing completion. The purpose of this study was to ascertain practices employed by restaurants, the extent of their participation in special promotional activities such as June Dairy Month, the profitability of milk relative to other beverages, the type of point-of-purchase promotional material used most frequently and most suitable for restaurants, and relate these factors to the volume of dairy products sold through such establishments. A report of the results is being prepared. It is anticipated that this report will be released in early 1963.



Plans have been developed for cooperative research with the American Dairy Association to determine the sales response for various levels of promotional investments. This work utilizes Federal and State order milk market data supplemented by data obtained by observations of support by dealers in six markets. The markets have been selected, and it is tentatively planned to initiate the fieldwork March 1, 1963.

#### Butterfat Testing and Price-quality Relationships for Butter

Work on butterfat testing and price-quality relationships for butter will be completed during the present fiscal year and the resources shifted to the economic analysis of protein and solids-not-fat content as a basis for purchasing milk.

#### Marketing Costs, Margins and Efficiency

Work has been initiated during the present year on a study of the relative efficiency of different methods of managing the total milk supply of a market, comparing centralized management (for example, in the hands of a cooperative) with decentralized management where each firm handles its own milk supply.

#### Procurement Practices of Marketing Firms.

Research on procurement practices will be continued. This research is an important part of many projects reported under other principle headings. Studies of decision-making in South Dakota dairy manufacturing plants, long-distance movement of milk, and drive-in dairies in the West will be completed this year. Research on milk price wars will be completed during the coming year. Studies of the structure of fluid milk markets, information systems for managerial decision-making in fluid milk plants, and preliminary work on wholesale market structure and channels will be initiated.

Analyses of the competitive position of the Western region relative to other major commercial regions will be completed.

### 3. Problems Requiring New or Additional Research

#### Utilization of Dairy and Cereal Products through Public Food Distribution Programs

A study of distribution procedures and end-uses for dairy and cereal products by recipients would provide information which may assist in increasing levels of effective utilization of these foods through public food distribution programs, particularly in schools and charitable institutions. This evaluation would include distribution of fluid milk through the Special Milk and National School Lunch Programs as well as operations of the Direct Distribution Program.

#### Expand Research on Improved Dairy Products

The recent sharp drop in per capita consumption of fluid milk has aggravated the serious dairy problem, resulting in a substantial rise in Government purchases of dairy products. Urgent need exists for the development of consumer acceptance of dairy products which will provide a stimulant to expanded uses with increased returns to producers. In this connection,



expanded research should be undertaken to assess the potential for both full and modified fat products as a basis for: (1) Encouraging commercial adoption of products having consumer acceptance and sales ability; (2) providing program agencies with evaluations of the economic impact of such improved products; and (3) developing market intelligence as products move through the laboratory which enhances consumer acceptance and chances of commercial success. Cases in point include: Dried whole milk presently in laboratory development which needs penetrating market analyses through product testing in hundreds of institutions and households to provide guidelines for further technical improvements. Also low fat (2 percent) milk has been introduced in a number of markets and should be studied to ascertain extent of penetration, acceptance and degree of replacement for other liquids, impact on total consumption, etc., and the need for laboratory research to develop a low-fat dried product. To adequately answer the questions of impact and potential, of low fat milk, distribution data must be collected from about 70 Federal Market Order market areas, and detailed studies of sales and substitution will need to be obtained through store audits of all major chain stores in a minimum of five major market areas.

#### New Containers for Milk and its Products

Increasing marketing costs--particularly of packaging and delivery--are of growing concern to producers, distributors and consumers of milk. Expanded research is needed in the evaluation of new and improved milk containers that (a) are less expensive; (b) require less costly equipment, less power, less space, and less labor to fill and move to storage; (c) are more durable and easier to deliver; (d) are suitable and more convenient at point-of-sale or use; and (e) will stimulate consumer acceptance and increased consumption. (Recommendation of Dairy Research and Marketing Advisory Committee, December 15-17, 1958, and December 6-8, 1960)

#### Improved Merchandising Methods

Although consumption of fresh whole milk has about kept pace with population growth, per capita consumption of milk in all forms has declined over a period of years. The dairy industry is concerned over this trend and would like to have its possible causes investigated. Expanded research on merchandising methods with emphasis on retail store availability and methods of merchandising fluid milk byproducts such as cottage cheese, sour cream, and modified-fat fluid milk; and ice cream particularly with reference to optimum package type (rectangular or cylindrical) could provide information that would help increase market outlets. (Recommendation of Dairy Research and Marketing Advisory Committee, December 15-17, 1958, and December 7-10, 1960.)

#### Evaluation of Different Media in Promotion of Fluid Milk

In view of the great importance of the fluid milk industry and the amounts being spent by producer organizations in promotion work, more attention should be devoted to an evaluation of the effect of different media on the sales of fluid milk.

Producer organizations use most advertising media, but have no information on their relative effectiveness. The lack of such information renders insolvable such problems as which media to use to accomplish specific objectives and whether promotional expenditures should be spread over all media or should be concentrated in a few. Research on media evaluation would be



aimed at providing useful information in this problem area. (Recommendation of Connecticut Milk for Health, Inc., January 1959.)

### Evaluation of Psychological Appeals in Advertising Fluid Milk to Teenagers

The dairy industry feels that teenagers offer an important potential market in terms of expanding the demand for fluid milk. However, little is known as to what psychological approach would be most effective from the standpoint of stimulating teenage interest in milk consumption. Themes, copy, and media are currently developed on an intuitive basis which may or may not strike a responsive note in stimulating consumption of milk among teenagers.

Research on sales responses to selected psychological approaches would be directed at narrowing this area of uncertainty so that appeals, themes, and copy could be developed on a sounder basis. (Recommendation of American Dairy Association, July 1960)

### Distribution and Consumption Patterns for Dairy Products

Information is needed on the distribution patterns for fluid milk and other dairy products to aid in planning promotional strategy by various dairy interests. Critical needs are for information pertaining to consumption patterns by different age groups, income groups, geographic areas, and urban areas. Industry groups have need for such market profile information to better define their targets in advertising and promotional campaigns which are designed to expand the market for dairy products. (Recommendation of American Dairy Association, July 1960)

### Evaluation of Effect of Point-of-Sale Merchandising Material

The American Dairy Association and other industry groups spend considerable promotional funds on point-of-sale merchandising material for the purpose of stimulating sales of dairy products at the retail level. In order that these materials might be made more effective, an evaluation should be made of the effect of specific types of materials on consumer purchases. The results of such an evaluation would provide the industry with guidelines they could use in making these materials more effective. (Recommendation of American Dairy Association, July 1960)

### Evaluation of Decision-making Process in Use of Dairy Products in Food Uses and Food Preparation

A study of sources of knowledge used by homemakers in decision-making in dairy product uses and preparation is needed. The results of this study would indicate the potential of recipes and similar type of material as an approach to encouraging use of dairy products. Dairy promotional organizations could use this information in choosing alternative promotional procedures such as recipe booklets versus regular advertising, etc. (Recommended by American Dairy Association, July 1960)

### The "Image" of Dairy Products as a Food for Outdoor Eating

Cookouts accompanied by outdoor eating appears to be gaining wide acceptance by consumers. Some in the dairy industry have hypothesized that the trend toward outdoor eating adversely affects consumption of dairy products. Research should be initiated to determine consumers' attitude or "image" relative to dairy products as an outdoor food. This would



include such evaluations as the "image" of milk as a beverage, butter as a spread, and ice cream as a dessert. Information of consumer attitudes toward dairy products as an outdoor food could be used by the dairy industry in developing promotional programs aimed at this segment of the market. (Recommended by American Dairy Association, July 1960)

#### Costs of Manufacturing Ice Cream

Information on costs of manufacturing ice cream is almost nonexistent. Research should be initiated to provide current reports of the costs of manufacturing ice cream and ice cream mix, in order to provide a basis for improved decision-making by dairy plant managers and by those responsible for determining prices of milk utilized in ice cream.

The present report of fluid milk marketing costs and margins should be expanded to include ice cream operations of these firms, providing valuable information which is presently unavailable from any other source.

#### Costs of Seasonality of Production

The impacts of the present wide seasonal variation in milk production and consequent underutilization of milk handling and processing facilities on marketing costs for fluid milk and manufactured dairy products should be evaluated and the possible effects on costs of various reductions in the seasonality of production determined.

Research nearing completion indicates that reductions in labor costs with even seasonal production of manufactured dairy products are relatively small. The effects of such a shift on costs of equipment and facilities, procurement costs, and marketing costs in both manufactured products and fluid plants should be analyzed.

#### Marketing Implications of Large-scale Milk Production

Marked increases in size of dairy herds may have significant effects on milk procurement costs and methods and on competitive relationships among milk dealers, and on relationships between producers and dealers. Research needs to be initiated to study the effects of large-size herds on (a) costs of milk transportation and receiving, (b) field services, and (c) control of seasonality of milk supplies. The number of herds with more than 100 cows is increasing. Herds of this size have the potential of reducing marketing costs in several ways. The possible reductions in costs should be evaluated as a basis for a general understanding of the marketing forces that may be involved in current trends in sizes of dairy farms. Such a study should help with adjustments in business relationships between dealers and producers as the size of farm changes.

#### Wholesale Dairy Market Structure and Organization

Information about the channels of trade through which manufactured dairy products move is fragmentary or obsolete. Knowledge about the types of buyers in the wholesale market is limited, with the result that pricing practices are not well understood. Research should be initiated to provide knowledge about wholesale distribution channels, types of buyers, margins, pricing practices, and related information.



More complete information about the channels of distribution for manufactured dairy products would contribute to better understanding of the problems involved in the establishment of prices, the adequacy of prices reported at terminal markets, and advantages and limitations of reporting prices for additional levels of distribution and additional forms of dairy products.

#### Pricing Milk for Nonfluid Uses

Complicated problems of pricing milk for nonfluid uses beset administrators and marketing firms. A study of all of the elements of the problem would indicate fruitful approaches to price setters, buyers and sellers of such milk.

Prices of milk for nonfluid uses determined under marketing orders have important impacts on its use in various manufactured products. Competition from other forms of ingredients, particularly for soft products such as ice cream and cottage cheese, make it imperative that the relationships between order prices of milk for nonfluid uses and prices of alternative ingredients be held at competitive levels. Costs of manufacturing various products vary from one area to another depending on wage levels and seasonality and scale of operations. Careful analysis will be needed in order to determine the principles of pricing milk for these uses under the complicated conditions of modern marketing.

#### Interregional Competition in Milk Marketing

As milk markets and supply areas grow in size, they more and more impinge upon each other. The increasing mobility of milk supplies between markets has also served to accentuate problems of price relationships between markets. Research should be initiated to study the relationships of prices and milk supplies between markets and between supply areas, with particular emphasis on the relationships between Eastern Seaboard, Midwestern, and Southern markets.



## IMPROVING MARKETING OPERATIONS THROUGH RESEARCH WITH FARMER COOPERATIVES

## 1. Program Changes for Fiscal Year 1963

Professional Man-Years	F.Y. 1962 Base	Changes in F.Y. 1963
Dairy	4.3	-0.4

## 2. Plans for Use of Current Resources through Fiscal Year 1964

Coordination of Marketing

This research includes investigations of potential benefits of improved coordination of cooperative programs. A study of the economic feasibility of a coordinated marketing program for cooperatives serving major market centers in Tennessee and Kentucky is near completion. This will be followed by a similar study in a midwestern area. Short-time studies are to be made of specific proposals for merger and other methods of realizing closer coordination of cooperative marketing programs. Studies of the bargaining programs of cooperatives are to be made from time to time at their request.

Pooling and pricing

The marketing role and pooling methods employed by dairy cooperatives are being studied by a program of descriptive and analytical research. A study of the marketing role of dairy cooperatives in Federal order markets is to be completed this year. This will be followed with a study of the methods individual cooperatives employ in pooling and distributing marketing proceeds to patrons. This work is in cooperation with ERS and ASCS.

Improving operating methods and efficiency

Studies are being made of operating methods and efficiency of operations of dairy cooperatives. A program for comparing operating costs of midwestern plants is to be discontinued this year. Short-time studies of operating methods and costs are made at the request of cooperatives, usually employing analysis of statistical and accounting data to make comparisons with similar operations and research results.

Merchandising manufactured products

This research explores the merchandising of manufactured products as related to the buying methods and product needs of users. A study of the marketing methods and experiences of cooperatives in selling nonfat dry milk to commercial users is to be completed next year. This will be followed with a similar study for marketing butter.



### 3. Problems Requiring New or Additional Research

#### Coordinated marketing by dairy cooperatives

Based on potential application of research now underway additional research is needed concerning methods of achieving greater horizontal integration of dairy cooperatives, thereby improving their performance both on the basis of efficiency of operation and as bargaining agencies. A case study has been proposed including analysis of existing facilities and operations, and analysis of alternative methods for reorganizing cooperatives in an area, these methods to include federations or contractual agreements, as well as outright consolidation or merger.

#### Pooling methods for dairy cooperatives serving large geographic areas

Findings of current studies indicate a need for additional research of pooling methods needed by cooperatives that serve producers and markets covering a large geographic area. Pooling methods now used by cooperatives serving a single urban area may be unmanageable, or may lead to unfair treatment of some farmers, as cooperatives expand to serve larger areas.

#### Cost accounting system for dairy manufacturing plants

Current studies of cooperative manufacturing plants show an increasing scale and complexity of their operations. This points to the need for a uniform accounting system based on departmentalization of operating costs. This system would make possible improved inter-period comparisons for individual plants, improved inter-plant comparisons, and increased use of findings of other cost studies. It would also provide a yardstick for determining the best alternative uses for milk.



## SUPPLY, DEMAND AND PRICE

## 1. Program Changes during Fiscal Year 1963

Professional Man-years	F.Y. 1962 Base	Changes in F.Y. 1963
Dairy		+0.5

## 2. Plans for Use of Current Resources through Fiscal Year 1964

Technical demand and supply studies provide quantitative knowledge of the interrelationships among prices, production and consumption of farm products. These studies have become increasingly useful in making price, supply and consumption projections and in economic appraisals of alternative Government programs. For example, the continuing strong tendency for farm production to exceed market outlets at favorable prices has resulted in number of agricultural proposals and changes in agricultural programs such as passage of the recent feed grains program. The longer-run impact of such programs cannot be fully evaluated without better quantitative analyses indicating the kind of price, demand and supply interrelationships that can be expected between feed grains and livestock and livestock prices. The present statistical formulations have serious gaps, especially in determining how producers will respond to these programs and what effect their actions will have on supplies and consumption.

The current level of resources limit the amount of research that can be carried out in the various phases of price, supply and consumption analysis. Resources have to be shifted from commodity to commodity and from one line of work to another in order to provide answers to the most pressing questions.

The major research objective in the next two years will be a comprehensive analysis of the price-making forces in the feed-livestock economy. Based on results of statistical analysis from completed projects, and those now underway and planned, an economic model will be formulated for the feed-livestock economy and fitted statistically. Special attention will be given to quantitative measures that show what happens to the production of each commodity within this sector following changes in price of one or more commodities. Analyses will be made for the United States as a whole and whenever necessary for homogeneous production regions to measure differences in price response and to allow for the important farm and nonfarm alternatives in each region. The statistical model will be designed in such a way as to be of maximum value for analyzing probable effects of alternative types of Government programs for feeds, livestock and livestock products. The parts of the feed-livestock study that will be undertaken through fiscal year 1964 are discussed under plans for each of these commodities. With present level of funds, work in some of the individual commodity areas cannot go beyond the minimum required to provide a satisfactory basis for an overall study of the feed-livestock sector.



Research in dairy will be concerned with the additional analyses needed to incorporate dairy in the overall model of feed-livestock economy. It will include a study of the impact of changes in prices and supply of feed grains on the production of milk, and the interrelationships between price and production of milk and prices and production of livestock and other livestock products. Attention will also be given to factors underlying the rapid rise in production per cow and corresponding decline in cow numbers.

### 3. Problems Requiring New or Additional Research

#### Analysis of Factors Concerned in the Decline in Milk Consumption.

Consumption patterns of several dairy products have undergone substantial changes since the last comprehensive study in demand for dairy products was made in the mid 1950s. These changes are still occurring and are critically affecting the production - utilization balance of milkfat and solids-not-fat. This has further aggravated the problem of continued surpluses in dairy products. To provide guides for the dairy industry and USDA programs for maintaining and increasing use of milk, special effort is needed to identify and determine the effects of new pressures which bring about trends and shifts in milk consumption.

#### Analysis of Factors Affecting Supply Response.

During the post World War II period, the dairy industry has been in a state of flux with a substantial drop in number of dairy farms offset by continued increases in size of herds and in productivity per cow. We are just beginning to have sufficient historical data to observe and statistically measure the impact of some of these dynamic changes on production of milk. With the continued problem of dairy surplus, analyses of the factors affecting supply and price of milk are urgently needed to provide bases for evaluating different proposed programs for coping with the dairy surplus problem.

#### Fats and Oils--Analysis of Competitive Position of Cottonseed, Soybeans, Butter, Lard and Other Fats and Oils.

During the last decade, the shift from fats and oils of animal origin to those of vegetable origin has had major impact on the fats and oils industry. Little research has been done on fats and oils since the early 1950s. Furthermore, these analyses were based almost entirely on prewar relationships. A comprehensive study of the changing competitive positions of cottonseed, soybeans, butter, lard and other fats and oils is needed. An analysis of the factors affecting the supply and demand for soybeans, now the primary source of oil, is especially needed because of their increased importance since the last comprehensive research was done. In addition, exports of food fats and oils have become increasingly important as an outlet for these commodities and now account for about one-third of our output.



## COMMODITY SITUATION AND OUTLOOK ANALYSIS

1. Program Changes during Fiscal Year 1963<sup>4</sup>

Professional Man-years	F.Y. 1962 Base	Changes in F.Y. 1963
Dairy	1.5	+0.5

## 2. Plans for Use of Current Resources through Fiscal Year 1964

Presentation of the regular appraisal of the current and prospective economic situation of milk and milk products in Situation Reports and other outlook materials will continue. Probable increases in milk production in 1963 and 1964 are expected to maintain production well above consumption. Hence, there is a great deal of interest in alternative dairy programs. During the coming year, emphasis will be on analyzing the impact of various factors on the volume of milk marketed in order to obtain basic information for the development of price support, production and marketing programs. This will include projections showing the effect of various kinds of programs on production, prices and farm income. The continuing decline in consumption of milk and dairy products indicates a need for more detailed study of the factors concerned in this decline. Attention will be given to analyzing changes in economic conditions which may be associated with changes in milk and dairy product consumption. Statistics to bring to date material published in Statistical Bulletin No. 303, as well as significant new statistical series, will be published as a Supplement to Statistical Bulletin No. 303.

## 3. Problems Requiring New or Additional Research

Research is needed to develop (1) a method of accounting which will more adequately reflect both fat and nonfat solids of milk and dairy products; and (2) establish a new statistical series for milk consumption based on the new accounting method. New statistical series reflecting use of both fat and nonfat milk solids will make possible more effective analysis of the economic and other factors affecting trends and shifts in milk consumption. The present method of accounting on fat content presents a distorted picture of milk consumption since it inadequately recognizes the increasing use of low fat and skim milk products.



## CONSUMER PREFERENCE AND QUALITY DISCRIMINATION

## 1. Program Changes in Fiscal Year 1963

Professional Man-years	F.Y. 1962 Base	Changes in F.Y. 1963
Washington, D. C.		
Consumer preference		+1.2

## 2. Plans for Use of Current Resources through Fiscal Year 1964

Planning will be initiated on a study to be conducted in cooperation with the Economic Research Service on homemakers' use of and opinions about selected dairy products, including reactions to a low fat milk product. The study will probably be conducted in 2 or 3 cities late in calendar 1963.

Assuming that (a) work already underway progresses according to plans, and (b) funds are continued at the present level, several additional projects dealing with various commodities, including dairy, may be undertaken in fiscal 1964. The actual number will depend upon the size and scope of the particular problems selected for study. The exact choice of problems cannot be made this far in advance, since to a large extent decisions will depend on the relative urgency of problems as they appear at that time. However, the areas from which we now expect that additional studies may be developed include:

Dairy consumption, particularly as it may be affected by consumers' concern over weight-loss, cholesterol, and fallout.

## 3. Problems Requiring New or Additional Research

Consumer Preferences for Dried and Concentrated Milk

To give direction to laboratory research and provide an evaluation of possible consumer acceptance of these milk products, studies of consumers' ability to detect off-flavors, and their preferences for specific flavors should be initiated.

Consumer Attitudes toward Cheese and Butter

Consumer research on acceptance of and preferences for non-fluid milk forms, particularly cheese and butter, is needed to implement industry's effort to expand household consumption of these products.



## NUTRITION AND CONSUMER-USE RESEARCH

## 1. Plans for Use of Current Resources through Fiscal Year 1964

When the revision of Agricultural Handbook No. 8 "Composition of Foods" is completed in 1963, work will go forward on adaptation of this data into revisions of less technical and more widely distributed publications, such as Home and Garden Bulletin No. 72, "Nutritive Value of Foods."

Research on nutritive value of foods will be continued at the present level, with continuing emphasis on obtaining fatty acid, protein and amino acid, carbohydrate, mineral and vitamin content for foods for which this information is not now available. Some shifts in commodity emphasis will occur as current lines of work are completed and new ones undertaken. The continuing objective will be to obtain new knowledge of nutritive values of all foods as rapidly as resources permit.

Completion of lines of work on household food uses, such as fats and oils in baked products, will permit initiation of a small number of new lines within the area of the relationship between food properties and consumer qualities.

In the area of food economics and diet appraisal emphasis will be shifted from special-purpose surveys to planning and preparation for a nationwide survey of household food consumption. Work on preparing guidance materials for improved household food management and nutrition would be continued at present levels.

Basic work in human metabolism, requirements for nutrients and functions of nutrients would be continued with the purpose of adding to the currently inadequate knowledge of relationships between food intake and nutritional needs of persons of various ages and engaged in various levels of physical activity.

2. Problems Requiring New or Additional Research

Continuing basic research on human requirements for nutrients and food, and how best to meet these requirements, is essential to undergird the national programs of food production, processing, marketing, and consumer education in nutrition and food use. Additional background essential for such programs can be obtained by periodic surveys of the kinds, amounts, nutritive value, and costs of food consumed by different population groups; the practices in the preparation of food for eating that affect food quality; and the levels of nutritional well-being supported by prevailing food consumption patterns. Data on nutritional needs, nutritive values, and relative costs of different types of food, and on trends in food and nutrition, are also needed for improved food budgets and guides for food selection and meal planning by households and individuals.

Food must provide the many nutrients essential for well-being, and more knowledge is needed on the nutrient composition and biological value of commonly used foods including how various conditions and practices of production, processing, and handling affect these values. The next periodic national survey of food consumption should be conducted in 1964, to determine the extent to which food consumption of various population groups are now in accord with current knowledge of nutritional needs for human well-being.



## MARKETING SERVICE AND EDUCATION

## Dairy Statistics

Three specific areas of need were discussed by the Dairy Research and Marketing Advisory Committee which resulted in recommendations that have not been implemented. They are cited below for purposes of review and re-evaluation:

1. Milk Production and Utilization

Expand work to provide more comprehensive and more accurate estimates of production and utilization of milk produced on farms. Such a program would include monthly estimates of milk production for 14 of the 50 states not currently making such estimates, as well as providing monthly estimates of number of milk cows on farms and production per cow by states. More complete data are needed on production of milk for fluid and manufacturing use by states, number of farms with milk cows with some breakdown by size groupings, current milk equivalents and yields of dairy products. Additional detail on grain and concentrate and roughage rations being fed to milk cows would be desirable. (December 1958 meeting.)

2. Consumption of Fluid Milk Products

Broaden present limited program of per capita consumption estimates of fluid milk products to provide data by States annually. Such a program would make possible a continuing series of annual estimates of consumption of whole milk, skim milk, milk drinks and cream on a product basis, both per capita and in total by States and possibly by markets in some areas as well as the United States. (December 1958 meeting.)

3. Reporting of Fluid Milk and Cream Prices

Improve the present system of reporting fluid milk and cream prices monthly by a thorough study of current sources and methods by which the prices are reported. This would include an inquiry into the adequacy of prices reported currently and an examination of the prices at the market level to determine if the quotations are accurately reflecting changes in marketing practices. Such an inquiry would also assess current reports as to their accuracy and completeness in reflecting true prevailing prices to producers and consumers in each market. The analysis should investigate the necessity of developing methods of reporting other than the voluntary reports presently used and improvements that are possible if new methods should be adopted. (December 1958 meeting.)



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